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REPORT TO CONGRESS

REIMBURSEMENT OF RURAL REFERRAL CENTERS UNDER THE MEDICARE PROSPECTIVE PAYMENT SYSTEM

OTIS R. BOWEN, M.D.
SECRETARY

DEPARTMENT OF HEALTH AND HUMAN SERVICES

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REIMBURSEMENT OF RURAL REFERRAL CENTERS UNDER MEDICARE'S PROSPECTIVE PAYMENT SYSTEM

EXECUTIVE SUMMARY

Under the Prospective Payment System (PPS), some differences in costs among rural hospitals are explicitly recognized. One group thought to have higher costs are the "Rural Referral Centers" (RRCs). Specifically, the 1983 SSA amendments require that

> The Secretary shall provide for such exceptions and adjustments under this subsection as the Secretary deems appropriate to take into account the special needs of regional and national referral centers (including those hospitals of 500 or more beds located in rural areas)...(Section 1886(d)(5)(C)(i)).

A number of factors have been suggested as causes for RRCs' supposedly higher costs:

1) Their more complex cases require costly special equipment and facilities.

2) The special facilities and complex cases require more highly skilled workers than other rural hospitals. These more specialized workers will be paid more than other workers (e.g., a nurse trained for open-heart operations will receive more than floor nurses). Therefore, costs will be higher.

3) To hire these special workers, RRCs compete with urban hospitals which pay higher wages, and this raises RRC payroll costs.

4) RRCs have higher overhead costs on average because the small number of complex cases may not keep special facilities or equipment fully utilized.

5) Referral cases are likely to be those that are the most severe <u>within</u> each Diagnosis Related Group (DRG). Therefore, the referral centers' costs will be above the average on which the prospective payment is based.

Ascertaining the extent to which these factors are applicable to qualifying RRCs was the primary purpose of this report. A second purpose was to determine the extent to which these factors explain RRCs' costs. It is possible that other factors, such as the mix of cases across DRG categories, account for most of the cost differences between RRCs and other hospitals, in which case the RRC costs were covered by DRG-specific payments. Finally, this study permitted an evaluation of the criteria by which RRCs are defined. It is possible that Congress's desire to meet the "special needs" of referral centers would be better served by somewhat different criteria than those presently employed.

To study these issues, case studies of six RRCs were combined with computer analyses of data from Medicare Cost Reports and the American Hospital Association (AHA) annual surveys. The major empirical conclusions are:

1. RRCs' 1984 costs are 13 percent higher than those of other rural hospitals when case mix severity, teaching, and wage differences are taken into account.

2. The higher RRC costs appear to be largely "explained" by their proportion of referral cases and their larger number of beds or other factors, which are proxies for unknown excluded explanatory variables.

3. Holding case mix severity, teaching, and wages constant, RRCs' costs are about 10 percent lower than average urban hospitals. This difference is statistically significant.

4. The RRC/urban cost differences appear to be largely explained by proportions of outlier payments. That is, RRCs receive proportionately more outlier payments than other rural hospitals but fewer than urban hospitals.

5. RRCs pay wages that are 6 percent higher than the level prevailing in their labor market areas. This would not be corrected by a separation of the rural wage rates for areas adjacent to urban areas from those areas not adjacent.

6. High-cost-outlier RRCs were not found to be any nearer to Standard Metropolitan Statistical Areas, which could have explained their higher costs.

7. "Large" rural teaching hospitals are not more costly per case than "small" rural teaching hospitals when case mix severity and wages are taken into account.

These findings support the following policy recommendations:

- RRCs should be paid a Federal rate that is appropriately lower than the urban rate. HCFA has proposed reducing the basis for calculating the RRC rate from the full urban rate to the rate for urban non-teaching hospitals. This would bring RRCs' operating margins more in to line with other hospitals' operating margins.

- If new adjustments to PPS payments are made, the RRC Federal payment rate should be recalculated based on new PPS parameters. The RRC problem is part of a larger payment problem for large hospitals as a group. Several refinements to PPS are being considered, such as a "referral variable." If these refinements can be perfected and adopted, RRCs may need no separate adjustment.

- No adjustment should be made in the labor-related portion of the RRC's Federal standardized payment amount separate from a systemic correction of the Federal wage adjustment. RRCs pay higher wages on average than other rural hospitals in their market area, partly because RRCs have a higher proportion of highly skilled employees. However, this wage differential would not be addressed by redefining hospital labor market areas by the Bureau of Economic Analysis (BEA) economic areas or by dividing current State rural areas by proximity to an urban area.

- No special adjustment should be made for large rural teaching hospitals beyond the existing add-on for indirect medical education costs and perhaps some systemwide refinement employing an additional hospital output measure. Holding case mix, wages, and teaching involvement constant, large rural teaching hospitals (with a major teaching involvement of at least 0.25 residents per bed) are not more costly per case than small or minor teaching hospitals and will not fare worse under PPS than will the minor teaching hospitals.

Research focused on the Medicare costs and revenues of RRCs has clearly shown that these hospitals, while having higher costs than other rural hospitals, do not have costs that equal those of urban hospitals. The initial method of payment for RRCs--the urban rate applicable in the closest MSA--has been overly generous. Therefore, RRCs have obtained the highest positive Medicare operating margin under PPS of any major type of hospital. Paying RRCs only the rural rate would have a large negative impact on all RRCs. However, continuing to pay the full urban rate would inappropriately result in windfall profits, especially relative to other rural hospitals.

1.0 INTRODUCTION

1.1 Legislative Background

In each of the first 4 years of Medicare's PPS, there have been 20 different Federal rates used to calculate payments to hospitals for each DRG category. These rates differ according to each hospital's location in either an urban or rural area in one of the nine census divisions (18 rates) plus national urban/rural rates. In the fifth year of PPS, the nine census divisions will be replaced by only a national urban/rural distinction.*

The national, standardized FY 1987 urban rate is $520 higher than the rural rate.** This is in recognition of higher urban prices and other cost factors for which adjustments cannot yet be made. Some differences in costs among rural hospitals are also explicitly recognized. One group thought to have higher costs is called "Rural Referral Centers" (RRCs). Specifically, the 1983 amendments to the Social Security Act require that

> The Secretary shall provide for such exceptions and adjustments under this subsection as the Secretary deems appropriate to take into account the special needs of regional and national referral centers (including those hospitals of 500 or more beds located in rural areas)...(Section 1886(d)(5)(C)(i)).

In the absence of specific instructions as to the magnitude of the adjustment, such hospitals under PPS have been paid according to the urban rather than rural Federal payment rates.

*Except for Oregon, which moved onto fully national rates in fiscal year 1987.

**See Federal Register/Vol. 51, No. 226/Nov. 24, 1986/Table 1. The rates are standardized for differences in case mixes, area wage rates, cost of living in Alaska and Hawaii, indirect medical education costs and outliers.

The term "referral center" is vague. Further, no specific guidance in defining this group is available in the relevant health literature or in the congressional papers relating to Section 1886. Section 2311 of the Deficit Reduction Act (DEFRA) in June of 1984 stated that the criteria established by the Secretary should allow a rural hospital to apply for reclassification as a referral center on the grounds that certain of its operating characteristics are similar to those of a "typical" urban hospital in the same census region. These characteristics may include wages, the scope of services, the service area, and the mix of the medical specialties of the hospital's staff. These characteristics are thought to be related to higher hospital costs. The purpose of designating RRCs, then, was to grant these rural hospitals higher payment rates for Medicare patients so as not to penalize them for cost-related conditions that are outside their control. That is, outside their control short of drastically changing the nature of their case mix, refusing patients with complex cases, and shrinking in size.

1.2 Factors Affecting RRC Costs

A number of factors have been suggested as causes for RRCs' supposedly higher costs. All of them relate to the claim that these hospitals offer more specialized health care and receive a larger proportion of referred cases than other rural hospitals:

1) The more complex cases require costly special equipment and facilities.

2) The special facilities and complex cases require more highly skilled workers than other rural hospitals. These more specialized workers will be paid more than other workers (e.g., a nurse trained for open-heart operations will receive more than floor nurses). Therefore, costs will be higher.

3) To hire these special workers, RRCs compete with urban hospitals which pay higher wages, and this raises RRC payroll costs.

4) RRCs have higher overhead costs on average because the small number of complex cases may not keep special facilities or equipment fully utilized (e.g., because of the population density in the rural area, an RRC's CT scanner might be needed for only 2,500 cases a year while those in urban areas handle 4,800).

5) Referral cases are likely to be those that are the most severe within each DRG category for rural hospitals. Therefore, the referral centers' costs will be above the rural average on which the prospective payment is based.

Ascertaining the extent to which these factors are applicable to qualifying RRCs is one purpose of this report. A second purpose is to determine the extent to which these factors explain RRCs' costs. It is possible that other factors, such as the mix of cases across DRGs, account for most of the cost differences between RRCs and other hospitals, in which case the RRC is automatically covered by DRG-specific payment. Finally, this study will permit an evaluation of the criteria by which RRCs are defined. It is possible that Congress's purpose in seeking to meet the "special needs" of referral centers is better served by somewhat different criteria than those presently employed.

1.3 Defining RRCs

The definition of an RRC in the regulations has evolved in response to both the clarification of Congress's intent and inquiries and comments received by the Health Care Financing Administration (HCFA) on its published criteria. Changes have been explicitly aimed at identifying those hospitals that treat the sickest patients - that being a key characteristic of a referral center as envisioned by at least some members of Congress.*

*In making this point in the Federal Register, Vol. 49, No. 1/ Tuesday, January 3, 1984/p. 27, HCFA references the Congressional Record, Vol. 129, No. 34, March 17, 1983, S3224.

1.3.1 The 1983 SSA Amendments

Section 1886(d)(5)(C)(i) of the Social Security Act, as enacted by section 601(e) of the Social Security Amendments of 1983, stated only that the Secretary should provide for exceptions and adjustments to take into account the special needs of regional and national referral centers (including those hospitals of 500 or more beds located in rural areas). In addition to the importance of size, HCFA inferred from the terms "regional" and "national" in the legislation that a referral center would serve a substantial number of patients from outside the local area. Therefore the original criteria were that an RRC:

a. must be located outside any Standard Metropolitan Statistical Area (SMSA) or the New England County Metropolitan Area and have at least 500 beds, or

b. must have at least 60 percent of all Medicare patients residing out-of-State or more than 100 miles from the hospital (whichever is more stringent) and at least 60 percent of all services received by Medicare beneficiaries must be provided to Medicare beneficiaries residing out-of-state or more than 100 miles from the hospital. (FR/Vol. 48, No 171/Thursday, Sept 1, 1983/p. 39783)

1.3.2 The January 1984 Revisions

The comments on these criteria received by HCFA were "uniformly critical...emphasizing that the policy in the regulations was so restrictive that the hospitals could not qualify." (FR/Vol. 49, No. 1/Tuesday Jan. 3, 1984/p. 27) HCFA then modified the criteria to recognize actual referral patterns within a wide geographic region. In January, 1984, the criterion of residence out-of-state or over 100 miles away was replaced by residence 25 miles or more away. In addition, HCFA defined a referral center as having at least 50 percent of its patients come from other hospitals or from physicians not on the hospital's staff. HCFA stated that these criteria embodied congressional intent to help hospitals serving a substantial number of the sickest patients outside the local area.

1.3.3 The Final FY 1985 RRC Regulations

Section 2311 of DEFRA, which was enacted in 1984, stated that the criteria must allow a rural hospital to apply for reclassification on the grounds that certain of its operating characteristics are similar to those of a typical urban hospital in the same census region. These characteristics may include wages, the scope of services, the service area, and the mix of medical specialties of the hospital's staff.

In August 1984, a separate set of criteria was proposed to determine RRC status. This set included two mandatory conditions and a list of three others of which a hospital needed to meet only one:

Mandatory Criteria

1. A 1981 Medicare case mix index of at least 1.03,

2. At least 6,000 discharges for the most recent cost reporting period before application for RRC status is made.

Optional Criteria

3. One of the following:
   a. more than 50 percent of the hospital's medical staff are specialists,
   b. 60 percent of all discharges are for inpatients who reside more than 25 miles from the hospital, or
   c. at least 40 percent of all inpatients have been referred from other hospitals or physicians not on the RRC's staff.

The first criterion (an index of 1.03 or more) was selected to reflect the complexity of cases treated in a hospital. A referral center should have a case mix above that of the average rural hospital if it is treating the sickest patients. Alternatively, a hospital with an index of at least 1.1053 in the first cost reporting period subject to PPS could also qualify. The alternative index number was set higher because experience under PPS indicated that the average case mix index had risen in 1983 due to more complete and accurate billing data.

The second criterion (6,000 or more discharges) required a designated RRC to be above the average bed size and rate of utilization of other rural hospitals, as intended by Congress. The number 6,000 translates into a hospital of about 170 beds assuming a typical occupancy rate and average length of stay.*

The third criterion to be met by RRCs reflects the amount of "referral" activity associated with the hospital. Here HCFA moved away from its earlier emphasis on Medicare patients' travel and referral patterns to include all

*The number of discharges must exclude discharges from subprovider units.

inpatients in criteria 3b and 3c. Also, at this time, a specialist (referred to in 3a) was defined as a medical staff member who had completed minimal training requirements recognized by the American Board of Medical Specialties or the Advisory Board for Osteopathic Specialists. This criterion was included to permit hospitals that serve as referral centers for certain specialized areas of treatment to qualify as RRCs. It permited all family practitioners to be considered as specialists and so allowed virtually all hospitals to meet criterion 3a. (Because medical graduates are no longer choosing to become general practitioners, the proportion of specialists on hospital staffs will approach 100 percent within the next two decades.)

In response to this legislation, HCFA altered the mandatory casemix and discharge criteria published in July to allow a rural hospital to qualify as a referral center if its casemix index and number of discharges are at least the median values for the urban hospitals in its region. The alternate criteria for RRCs for fiscal years 1985 through 1987 are summarized in Table 1-1. The region-specific case mix and discharge thresholds are given in Table 1-2.

Another change in the August 1984 regulations was the requirement that there be a triennial review of all RRCs. This review would determine whether they would continue to be designated as RRCs.

1.3.4 The Final FY 1986 RRC Regulations

For FY 1986, the published case mix criteria were based on discharge data for FY 1984 (FR/September 3, 1985). The discharge criteria remained the same as for FY 1985 because more recent data were unavailable. (See Table 1-2.) As in the previous year, hospitals could choose either the national or regional urban median values as the thresholds for the case mix and discharge criteria.

1.3.5 The Final FY 1987 RRC Regulations

The referral centers studied in this report qualified under one of the above sets of criteria. However, the Omnibus Budget Reconciliation Act of 1986 (and the regulatory provisions that appeared November 24, 1986, in FR, Vol. 51, No. 226, pp. 42229-42235) revised the criteria that define RRC qualification. These revisions for initial applications made on or after October 1, 1986, as well as for the triennial review of existing referral centers include:

1. The scaling down (from 6,000 to 5,000) of the numbers of discharges needed either for initial qualification or retention of RRC status to reflect declines in total discharges in rural hospitals.

2. The scaling down of the case mix index values required either for initial qualification or retention of RRC status to reflect the actual increases in the national average case mix index and the regional urban median index values since 1981. The hospital must have a case mix at least equal to the median case mix for urban hospitals in the same census region (excluding hospitals with approved teaching programs).

Furthermore, OBRA 1986 provides that:

1. Any application for RRC status filed before January 1, 1987, and subsequently approved will be effective for discharges occurring on or after October 1, 1986. Otherwise, applications must be submitted in the quarter before the beginning of the hospital's cost reporting period.

2. Hospitals that are RRCs on the date of enactment will retain that status for cost reporting periods beginning on or after October 1, 1986 and before October 1, 1989.

3. Provisions pertaining to RRCs will be implemented to ensure that total payments remain budget neutral.

TABLE 1-1

ALTERNATE CRITERIA FOR REGIONAL REFERRAL CENTERS, FISCAL YEARS 1985-1987

Effective Starting Date of RRC Status	Case Mix Index (CMI)	Number of Discharges	Additional Criteria
FY 1985 (10/1/84-9/30/85)	a1. 1981 CMI ≥ 1.03	b1. 6000 or more discharges for 1981	c1. 50% of the Hospital's medical staff are specialists*
	or	or	or
	a2. CMI ≥ 1.053 in 1st reporting period under PPS	b2. Discharges ≥ region's median urban discharges for 1981 or most recent reporting period.	c2. 60% of Hospital's discharges are inpatients who reside over 25 miles from the hospital.
	or	or	or
	a3. CMI ≥ 1981 base regional median urban CMI (see Table 2, Column 1) or CMI ≥ adjusted regional median urban CMI in most recent reporting period. (See Table 2, Column 2, FY85)	b3. 6000 or more discharges for most recent reporting period.	c3. 40% of all inpatients treated at hospitals have been referred either from physicians not on hospital staff or from other hospitals.
FY 1986 (10/1/85-9/30/86) Based on discharges occurring during FY84.	a1. CMI ≥ 1.1294 (1981 CMI adjusted for % increase in Medicare case mix)	b1. 6000 or more discharges for FY84	Same as FY85
	or	or	
	a2. CMI ≥ Regional median urban CMI (adjusted for % increase, see Table 2, Column 2, FY86.)	b2. Discharges ≥ regional median urban discharges in 1984 (See Table 2, Column 3, FY86.)	
FY87 (10/1/86-9/30/87) Based on discharges occurring during FY85.	a1. CMI ≥ 1.1275 (actual national median Medicare case-mix index for all urban hospitals	b. Discharges ≥ 5,000 for FY85 (adjusted for decline in rural hospital discharges.)	Same as FY85
	or	or	
	a2. CMI ≥ regional median urban CMI (actual median Medicare case-mix index for all hospitals in region. (See Table 2, Column 2, FY87.)	b2. Discharges ≥ regional median discharges in 1985 (adjusted for decline in rural hospital discharges. (See Table 2, Column 3, FY87.)	Same as FY85

*A Specialist is defined as (1) a doctor who is certified as a specialist by one of the Member Boards of the American Board of Medical Specialties (ABMS) or the Advisory Board of Osteopathic Specialists (ABOS); or (2) has completed the current training requirements for admission to the certification examination of the ABMS or the ABOS; or (3) have successfully completed a residency program in a medical specialty accredited by the Accreditation Council for Graduate Medical Education or the American Osteopathic Association. All specialists who meet this definition can count toward meeting this criterion.

TABLE 1-2

CASEMIX AND DISCHARGE CRITERIA FOR RURAL REFERRAL CENTERS, 1984

REGION	(1) 1981 Median Urban Case Mix	(2) Adjusted Median Urban Case Mix			(3) Urban Discharges		
		FY85	FY86	FY87	FY85	FY86	FY87
1	1.055	1.132	1.157	1.075	7,467	7,467	6,682
2	1.071	1.149	1.174	1.071	8,601	8,601	7,697
3	1.035	1.111	1.135	1.112	7,785	7,785	6,967
4	1.046	1.122	1.147	1.093	9,309	9,309	8,331
5	1.010	1.084	1.108	1.083	8,330	8,330	7,455
6	1.022	1.097	1.121	1.113	8,515	8,515	7,620
7	0.972	1.043	1.066	1.101	5,888	5,888	5,269
8	1.056	1.133	1.158	1.158	9,928	9,928	8,885
9	1.073	1.151	1.171	1.159	5,564	5,564	4,979

Source: Federal Register, August 31, 1984, September 3, 1985, September 3, 1986, and November 24, 1986.

The 60 hospitals qualifying under the most recent regulations were not included in this analysis. Because these recent additions tend to have smaller Medicare case volumes and less complex case mixes than the 168 RRCs included in the analysis, the omission of their data should not materially affect the results of this report.

1.4 PPS Payment and Designation Issues for RRCs

The intent of Congress, as expressed in the legislative provisions for RRCs reviewed in the last section, was to provide adequate payments for rural hospitals that have higher than average costs because they treat patients who are sicker than the average in each DRG category. It was also suggested that RRCs may be similar to a "typical urban hospital in the same census region" and so would justify higher, urban payment rates.

While the characteristics of RRCs were not spelled out, HCFA was instructed to consider hospital size, the prices paid for inputs, the severity of cases handled within DRG categories, the mix and scope of services offered, and the geographic service area. The line of reasoning was that certain rural hospitals serve as referral centers for an area or population (which may be larger than the average). Therefore, these hospitals handle more severe cases within each DRG, have more specialized and expensive equipment on hand, and pay higher wages to attract more specialized medical staff. These characteristics cause these hospitals to have costs that are higher than those of their rural neighbors and similar to the costs of urban hospitals.

Five major questions need to be answered in order to evaluate this line of reasoning:

1. Are RRCs' costs higher than those of other rural hospitals?

2. If their costs are not higher on average, is there a subset of rural hospitals whose costs are higher (requiring a redefinition of RRCs)?

3. What are the sources of any differences in hospital costs? That is, can they be explained by the hospital's case mix index alone or are other factors also important?

4. Are RRC costs "similar" to the costs of urban hospitals? What does "similar" mean?

5. What payment rate is appropriate for RRCs?

It is possible that referral center costs are higher than those of other rural hospitals but that these differences are explained by RRCs' more complex cases (with higher DRG weights), differences that are accounted for under PPS already. On the other hand, the DRG weights may not fully capture the cost variations due to differences in the severity of cases within each category. If RRCs have higher costs because of more severe cases within DRG categories, it may be equitable to pay them rates that are higher than the rates paid other rural hospitals. Should these rates be as high as those paid to urban hospitals? Perhaps it is inappropriate to make RRCs prove that they are similar to urban hospitals instead of merely different from other rural hospitals. Urban areas include hospitals that are national referral centers for very complex procedures, such as transplants. But, if RRCs' case mix-adjusted costs lie between rural and urban hospitals, the full urban rate may be too generous.

The five major questions listed above can be broken down into more specific questions that relate to the claims made for RRCs:

- Do referral centers have a broader service area than other rural hospitals?
- Do they offer a broader scope of services?
- Do referral centers use more expensive equipment on average?
- Do they handle more severe cases within each DRG (i.e., holding DRG constant, do they handle cases with more complications or requiring more intensive care)?
- Do referral centers pay higher salaries? If so, for which types of personnel?
- Are the higher salaries due to a need to compete in a regional or national labor market for these specialists?
- Should the criteria for designating RRCs and their reimbursement rates be on a regional basis?

This study has examined a wide range of data bearing on these issues. The key empirical findings are discussed in the following section.

1.5 Summary of Empirical Findings

This report represents the first description of RRCs as a group. For this study, this group included 168 rural hospitals designated as RRCs as of summer, 1986. There were roughly 2,500 other rural hospitals and over 2,800 urban hospitals. As of June 8, 1987, however, there were 181 RRCs, 16 of which were also designated as Sole Community Hospitals (SCHs). Table 1-3 lists these 181 RRCs according to their teaching/non-teaching status and disproportionate share status.

We found that RRCs are located in every region of the country but 43 percent are in the South. In fact, over one-quarter of all the RRCs are in just five Southern states. This contrasts sharply to other rural hospitals which are disproportionately in the Central regions, North and South.

Private voluntary or Government ownership characterizes 92 percent of all RRCs. This is similar to the proportion for other rural hospitals and about 10 percent more than for urban ones. RRCs are more than 10 times as likely to be teaching hospitals as are other rural hospitals generally, and their residency programs usually involve an affiliation with a medical school. However, large or major rural teaching hospitals are not more costly per case than small or minor teaching hospitals and will not fare worse under PPS than will minor teaching hospitals.

The average RRC is more than three times the size of the average rural hospital whether measured in terms of beds (217 vs. 65), admissions (8,957 vs. 2,301), or patient days (55,758 vs. 12,753). In number of beds, an average RRC is only 10 percent smaller than the average urban hospital (which has 239 beds). However, in 1984, RRCs treated roughly 5 percent more patients per bed, on average, than did urban hospitals (42 vs. 39) but with 16 percent fewer inpatient days and 22 percent fewer full-time equivalent workers (627 vs. 802).

The differences between the three groups of hospitals are reflected in the lengths of stay and occupancy rates. RRCs keep patients one-half day longer than other rural hospitals (6.1 vs. 5.4) and four-fifths of a day less than urban ones (6.9). Other rural hospitals, as a consequence of fewer admissions and shorter stays, have much lower occupancy rates (49 vs. 70 percent in RRCs).

TABLE 1-3

NUMBER OF HOSPITALS DESIGNATED AS RURAL REFERRAL CENTERS

	Non-Teaching	Minor Teaching[a]	Major Teaching[b]	Totals
Non-DSH[c]	150	22	5	177
DSH	4	0	0	4
Totals:	154	22	5	181

[a] "Minor Teaching" RRCs are those with a ratio of interns and residents to bed of less than 0.25.

[b] "Major Teaching" RRCs are those with a ratio of interns and residents to beds of 0.25 or greater.

[c] "DSH" = disproportionate share hospitals.

Source: HCFA, Bureau of Eligibility, Reimbursement and Coverage

The average RRC has very active surgical and outpatient programs. It has more than three times the emergency and outpatient visits of an average rural institution and performs far more surgical operations, both absolutely and on a per admission basis. In these respects, RRCs are almost the same as urban hospitals.

Higher surgery rates are due to the greater severity of cases admitted to RRCs and urban hospitals. The Medicare case mix index, which measures the weighted average severity of cases treated, is 11 percent greater in FY 84 in the average RRC compared to other rural hospitals (1.11 vs. 1.00) and the same as in urban institutions (1.11). In keeping with this, RRCs offer a scope of services that is much greater than other rural hospitals and marginally greater than an average urban hospital.

In light of their greater case severity, it is not surprising to find that RRCs were $419 more costly per adjusted admission in 1984 than other rural hospitals ($2,198 vs. $2,779). RRCs were also $796 less costly than urban hospitals ($2,994 per adjusted admission). For Medicare patients alone, RRCs are $506 more costly than other rurals ($2,426 vs. $1,920) and $755 less costly than urban areas ($3,219).

When the effects of case mix, residency programs, and wages are taken into account in an unconstrained logarithmic regression model, RRCs are indeed more costly per case, by 10 percent, than other rural hospitals and about as costly as urban hospitals. However, if costs per admission are standardized, to constrain the effects of casemix, residents and wages to be those allowed under PPS, RRCs are $290 (about 13%) more expensive than other rural hospitals and $215 less expensive than urban ones (about 10%). Both differences are highly significant.

One-third to one-half of the RRC/urban difference and one-third of the RRC/other rural difference is related to the larger proportions of outlier cases in urban hospitals and in RRCs. Nevertheless, RRCs' operating costs still lie between those of the other two groups. A simulation of a fully Federal PPS payment using the 1984 cost and case mix data reinforced the conclusion that RRCs are more expensive than other rural hospitals, but not as costly as the average urban one. The urban national rate would have provided a significant shelter for RRCs in 1984, effectively holding only a few RRCs at real financial risk for treating Medicare inpatients.

Referring to the five major questions listed above, recently completed research (described below) offers answers to the first four:

1. RRCs' costs are higher than those of other rural hospitals even when case mix severity is taken into account.

2. No subset of rural hospitals with higher costs has been found that would suggest a redefinition of RRCs.

3. Case mix and the location of a hospital in a rural versus urban location explain 41 percent of the variation in hospital costs. However, teaching status, wages, and regional location are also major factors in accounting for cost differences.

4. Holding these characteristics constant, RRCs' costs are not similar to those of urban hospitals in that the difference of about $200 is statistically significant.

The issue of the appropriate reimbursement rate for RRCs is addressed in the next section.

1.6 Policy Implications of Findings

RRCs as a group are more expensive than other rural hospitals. This cost difference would not be covered if they were paid the national rural rate. That is, using 1984 data, RRCs were found to be net losers on average under a fully Federal rural payment rate. RRCs as a group are not as costly as urban hospitals. Granting them the urban base payment rate more than compensates them for their cost differences. Therefore, RRCs have obtained the highest positive Medicare operating margin from PPS of any major type of hospital. Accordingly, HCFA recommended reducing the basis for calculating the RRC rate. This would bring RRCs' operating margins more into line with other hospitals' operating margins.

1.7 Recommendations

1.7.1 The Appropriate PPS Rate for RRCs

Under PPS, RRCs are now being paid the Federal urban payment rate. Although RRCs' Medicare costs per admission are significantly lower than those of urban hospitals, this exception protects them from the underpayment inferred from these analyses. Higher PPS rates during transition protect them in the short run. However, in the long run the urban rate is unjustified. RRCs' costs are higher than those of other rural yet lower than those of urban hospitals.

Thus, HCFA recommends that:

- RRCs should be paid a Federal rate that is appropriately lower than the urban rate. This would bring RRCs' operating margins more into line with other hospitals' operating margins.

The RRC problem is part of a larger payment problem for large hospitals as a group. Several refinements to PPS are being considered, such as a "referral variable." If these refinements can be perfected and adopted, RRCs may need no separate adjustment. Therefore, HCFA recommends that:

- If new adjustments to PPS payments are made, the RRC Federal payment rate should be recalculated based on new PPS parameters.

1.7.2 The Rural Wage Index

Analysis shows that RRCs do pay higher wages on average than do other rural hospitals in their market area. In part, this is because they have a higher proportion of highly skilled employees, which produces higher than average salaries. However, this wage differential would not be addressed by redefining hospital labor market areas by the Bureau of Economic Analysis (BEA) economic areas or by dividing current State rural areas by proximity to an urban area. The rural wage redefinition must be a systemic one, not an adjustment for RRCs alone.

Therefore, HCFA recommends:

- No adjustment be made in the labor-specific portion of the RRCs' Federal standardized amount separate from a systemic correction of the Federal wage adjustment.

1.7.4 Large Rural Teaching Hospitals

Holding case mix, wages, and teaching involvement constant, large rural teaching hospitals (with a major teaching involvement of at least 0.25 residents per bed) are not more costly per case than small or minor teaching hospitals and will not fare worse under PPS than will the minor teaching hospitals. Therefore, HCFA recommends:

- No exception or special adjustment be made for large rural teaching hospitals beyond the existing add-on for indirect medical education costs of all hospitals with teaching programs.

1.8 Overview of Report

The next three chapters set forth the empirical analyses of this study. Chapter 2 describes the group of 168 hospitals that had been designated as RRCs as of summer 1986. Here, we briefly show where these hospitals are located, how large they are, what services they offer and what their costs are compared to other rural hospitals. Chapter 3 presents an analysis of hospital costs. The emphasis is on regression to hold case mix and other factors constant. Chapter 4 presents a discussion of what is known about RRCs' areas of service, the market areas from which they draw their labor, and their wage indexes within their labor markets. Finally, Appendix A provides an extensive description of the sources, construction, and contents of the data base used in this report.

2.0 CHARACTERISTICS OF RURAL RRCs DEFINED BY PPS CRITERIA

2.1 Introduction

The criteria to designate RRCs were developed with reference to the case mix index, number of discharges, and measures for the referral of patients (i.e., percentage of physicians who are specialists or the distance patients travel). To date, no one has examined these hospitals as a group or even described what they are like. That is the purpose of this chapter.

Here we present descriptive tables to show where RRCs are located, how big they are compared to other rural and urban hospitals, how severe their cases are, and what their costs are per discharge and per inpatient day. The data come from the 1984 Medicare Cost Reports of over 5,000 acute care hospitals merged with additional information from the 1985 annual survey of the AHA. The data set is described in Appendix A. For the purposes of this study, RRCs were defined as those hospitals that had been awarded the designation as of summer 1986, as relected in the FY 87 Medicare Impact File. There were 168 such hospitals.

2.2 Location of RRCs

There is no reason to expect RRCs to be evenly spread across the country. They should be primarily in States with more rural populations. Thus, the District of Columbia should have no RRCs, while farm States (e.g., Iowa and Kansas) are expected to have disproportionately large numbers.

This expectation is borne out, in part. Table 2-1 presents the proportions of RRCs (and other hospitals) across the nine Census divisions and the States. Ten States and the District had no RRCs in 1984 (see note to table). Half of these areas are among the most densely settled in the country (e.g., Rhode Island and D.C.). However, the other half might be thought of as rural. For example, Wyoming and Utah have vast areas that are very sparsely populated. Yet these States have a relatively large number of rural hospitals with no RRCs. Hence, "ruralness" *per se* does not ensure more RRCs.

TABLE 2-1

DISTRIBUTION OF RURAL REFERRAL CENTERS ACROSS STATES AND CENSUS DIVISIONS, 1984

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Total Number of Hospitals Analyzed	168	2496	2884
Divisions and States[a]			
New England	4.2%	2.0%	6.5%
Connecticut	0.6	b	1.1
Maine	1.2	0.7	0.7
New Hampshire	1.2	0.5	0.5
Vermont	1.2	0.5	0.1
Mid-Atlantic	5.4	3.7	15.4
New York	1.2	2.1	6.0
Pennsylvania	4.2	1.6	6.2
South-Atlantic	17.4	12.8	15.5
Delaware	0.6	b	0.1
Florida	1.2	1.5	6.0
Georgia	3.6	3.4	2.2
N. Carolina	6.0	2.8	1.7
South Carolina	1.8	1.5	1.1
Virginia	3.0	1.6	1.9
W. Virginia	2.4	1.7	0.6
East North Central	18.5	13.4	17.7
Illinois	2.4	3.4	5.0
Indiana	3.0	2.1	2.0
Michigan	3.6	2.9	4.1
Ohio	7.1	2.2	4.3
Wisconsin	2.4	2.8	2.3
East South Central	12.5	12.1	5.6
Alabama	1.2	2.8	1.9
Kentucky	6.5	2.6	0.9
Mississippi	4.8	3.7	0.5
West North Central	13.2	23.0	6.7
Iowa	3.6	3.9	0.9
Kansas	2.4	4.8	0.7
Minnesota	1.8	4.4	1.8
Missouri	1.2	3.0	2.5
Nebraska	1.8	3.2	0.5
N. Dakota	1.2	1.7	0.2
S. Dakota	1.2	2.0	0.2
West South Central	13.8	16.9	12.2
Arkansas	4.8	2.6	0.6
Louisiana	1.2	2.8	2.3
Oklahoma	5.4	3.0	1.5
Texas	2.4	8.5	7.8
Mountain	7.2	9.7	3.3
Colorado	0.6	1.8	1.0
Idaho	3.0	1.5	0.1
Montana	2.4	2.0	0.1
New Mexico	1.2	1.1	0.3
Pacific	6.6	6.1	17.2
Alaska	0.6	0.5	0.1
California	0.6	2.0	13.7
Oregon	2.4	1.5	1.2
Washington	3.0	1.7	1.9

[a]The following states are not shown in the table because they have no RRCs although they might have rural hospitals: Arizona, Hawaii, The District of Columbia, Maryland, Massachusetts, Nevada, New Jersey, Rhode Island, Tennessee, Utah, Wyoming. Because of these omissions and rounding error, state proportions may not add to divisional proportions.
b Less than .05%

Sources: HCFA Impact-FY87 File.

For those Census divisions with RRCs, urbanized States have lower proportions, however. For example, New England, the Mid-Atlantic, East North Central, and Pacific States had 53 percent of the resident 1983 U.S. population and almost 60 percent of the urban hospitals, but only a third of all the RRCs and about a quarter of other rural hospitals.* The Southern regions, West North Central, and Mountain States, with only 47 percent of the 1983 population, have disproportionately more rural hospitals (75 percent) and RRCs (65 percent).

These regional patterns do not hold for all States within the divisions. For example, Pennsylvania and Michigan's hospital industries are far less urban than those of other States in their regions. Similarly, the South-Atlantic and West South Central States can be labelled "rural" overall, but Florida and Texas have large proportions of urban hospitals. Perhaps the most dramatic State versus division difference is in the Pacific division where California turns the division which is otherwise a "rural" area into an "urban" one.

Figure 2-1 presents the distribution of RRCs in a map of the United States. The concentration in the East and the South contrasts sharply with the absence in the Mountain division and in the heavily populated states along the North Atlantic coast. In fact, just six States (Pennsylvania, Georgia, North Carolina, Ohio, Kentucky, and Mississippi), contain almost one third of all RRCs. This concentration may be very important in analyzing differences between RRCs and the other two categories of hospitals. Wages, medical practices, regulatory programs and malpractice costs vary widely across States. These regional differences may also mean that designation criteria and reimbursement rates should not be based on a national standard. This will be examined more closely below.

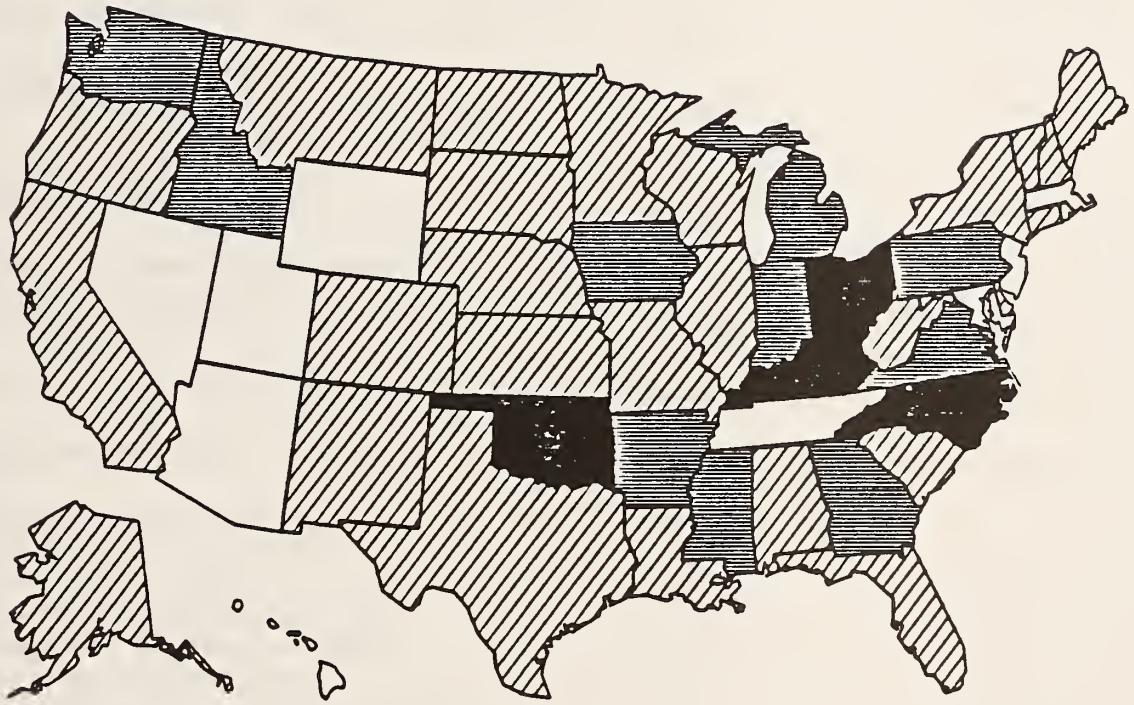
2.3 Market Characteristics of RRCs

A separate question about the location of RRCs is: How do the counties in which they are located compare with those of other rural hospitals? Table 2-2 presents mean values of key demand and supply characteristics for the counties with RRCs and other rural hospitals for the

*Population figures are from U.S. Bureau of the Census, Statistical Abstract of the United States 1985 (105th Edition) Washington, D.C., Dec. 1984, Table 11, p. 11.

FIGURE 2-1

DISTRIBUTION OF RURAL REFERRAL CENTERS BY STATE



NUMBER OF RRCS 0 1-4 5-8 9-12

SOURCE: MEDICARE IMPACT FILE

TABLE 2-2

CHARACTERISTICS OF COUNTIES IN WHICH RURAL HOSPITALS ARE LOCATED, 1984

	Rural Referral Centers	Other Rural Hospitals
Number of Hospitals Analyzed	168	2496
Population Characteristics		
Total Population (000's)(1982)	64	32
Population density (per sq. mile)(1982)	95	42
Percent of population 65 and over (1982)	12%	14%
Percent of population in Medicare Part A (1980)	13%	15%
Percent of population covered by health insurance (state level)(1980)	81%	80%
Per capita income (1982)	$9,452	$8,900
State Unemployment rate (1980)	8.6%	7.8%
County Health Care Resources		
Number of acute care hospitals per county (1983)	2.1	2.0
Number of hospital beds per thousand population (1983)	6.1	5.6
Number of patient care physicians per thousand (1982)	1.5	0.7
Number of specialist physicians per thousand population (1982)	1.2	0.6

Sources: Area Resource File

most recent years available. The service areas of RRCs and many other rural hospitals are not limited to the county in which they are located. Nevertheless, such a description adds to our picture of RRCs.

Counties with RRCs have twice the population of those with other rural hospitals, both absolutely (64,000 versus 32,000) and in density (95 people per square mile compared to 45). Our case studies indicate that this reflects the fact that RRCs are usually located in cities with a population of 20,000 to 49,000 as opposed to less populous villages or small towns. Location in larger towns may also contribute to the somewhat higher estimated income per capita ($9,452 vs. $8,900 in 1982) through the presence of non farm employment opportunities. However, the higher incomes may also be related to a slightly younger county population with more people of working age. The higher incomes are not correlated with higher unemployment rates in this data set, however, because these rates are for the State as a whole.

The other significant difference between RRCs' counties and those with other rural hospitals is in health care resources. Although the average number of acute care hospitals is the same, counties with RRCs have an additional 0.5 hospital beds for every thousand people, reflecting the fact that RRCs are three times larger than other rural hospitals on average. Also, the number of physicians available in the county is twice as great where there is an RRC, even allowing for the greater county population. However, the presence of a larger medical center does not appear to attract proportionately more specialists.

2.4 Ownership and Teaching Status

Table 2-3 summarizes two organizational characteristics of hospitals: their ownership and their teaching status. Compared to other rural hospitals, referral centers are more likely to be private, voluntary hospitals and less likely to be Government-owned. Neither type of rural hospital is very likely to be proprietary. For-profit hospitals are concentrated more in urban areas.

Although almost all RRCs have JCAH accreditation (compared to only 58 percent of other rurals), only about 18 percent are teaching hospitals in the sense of having residents in training. Most of the teaching RRCs (15 percent of all RRCs) are also affiliated with a medical school. Three percent of all RRCs (20 percent of teaching RRCs) belong to the Council of Teaching Hospitals (COTH). These figures contrast sharply with other rural hospitals, only 2 percent of which have residency programs and less than 1 percent of which are

TABLE 2-3

ORGANIZATIONAL CHARACTERISTICS OF RRCs vs. OTHER HOSPITALS, 1984

	RRC=1 Rural Referral Centers	RRC=0 Other Rural Hospitals	RRC=2 Urban Hospitals
Number of Hospitals Analyzed	168	2496	2884
Ownership			
Government	22%	38%	13%
Private Non-Profit	70	53	69
Private For-Profit	8	9	18
JCAH Accreditation	99	58	90
Teaching Involvement			
Residents per 100 beds[a] (all hospitals)	2.0	0.1	4.9
Residents per 100 beds[b] (teaching hospitals only)	10.7	6.2	14.4
Residents per 100 occupied beds (teaching hospitals only)	13.6	9.1	18.9
Affiliated with medical school	15%	*	28%
Member of COTH	3	0	12
Affiliated with nursing school	7	*	9

[a]Number of interns and residents summed over all hospitals in category and divided by the grand total of beds for hospitals in that category. Reflects the low number of teaching hospitals within each category.

[b]Number of interns and residents summed over teaching hospitals in each category and divided by total beds only for teaching hospitals in that category.

*Less than 1.0%

Sources: Medicare Impact FY87 File, American Hospital Association 1985 Annual Survey of Hospitals.

affiliated with any medical school.

Urban hospitals are much more likely to be teaching hospitals, whatever the definition. Over 30 percent have residency programs, 28 percent are affiliated with a medical school, and 12 percent are members of COTH. Teaching involvment is also reflected in the heavier use of residents in urban hospitals. Urban teaching hospitals have 14 residents for every 100 beds on average while RRC teaching hospitals have only 9.1; the average other rural hospital has 6.4. When the ratios are corrected for different occupancy rates, we find that this greater use of residents in urban areas does not change and that within the rural group, rural referral hospitals are still somewhat heavier users of residents (14 per 100 occupied beds versus only 12 in other rural hospitals). RRCs and urban hospitals are also far more likely to be affiliated with a nursing school than are other rural hospitals (7 percent of RRCs, virtually no other rurals, and 9 percent of all urban hospitals). Teaching involvement is believed to contribute to higher hospital costs. We will return to this issue in Chapter 3.

Congress has expressed particular concern for large rural teaching hospitals. Tables 2-4 and 2-5 present descriptive means for hospitals grouped according to two definitions of "major teaching hospitals." Table 2-4 defines teaching status according to the number of residents per bed. This is in keeping with other work (e.g., the Congressional Budget Office's November 30, 1984 memo on the impact of PPS). We define a "major" teaching hospital as having a ratio of residents per bed of at least 0.25. We have also presented hospitals defined as RRCs separately from other rural hospitals because RRCs are large hospitals in aspects other than teaching.

Table 2-4 reveals that in each category (major teaching, minor teaching and nonteaching) RRCs generally fall between urban and other rural hospitals. They have more beds and admissions than other rural hospitals but are smaller than urban ones except in the nonteaching category. Their Medicare case mix indexes and costs per Medicare admission also fall between those of the other two groups.

Major teaching hospitals are generally more costly per case than those with fewer than 0.25 residents per bed, which in turn are more costly than nonteaching hospitals. The exceptions are the two major rural teaching hospitals that are not RRCs. These two "major" teaching centers are actually tiny hospitals with 15 to 35 short-term, acute-care beds but high ratios of

TABLE 2-4

DESCRIPTIVE MEANS FOR LARGE TEACHING HOSPITALS AS DEFINED BY RESIDENTS PER BED, 1984[a]

	RRCs			Other Rural Hospitals			Urban Hospitals		
	Major Teaching	Minor Teaching	Non Teaching	Major Teaching	Minor Teaching	Non Teaching	Major Teaching	Minor Teaching	Non Teachi
Number of Hospitals	5	26	137	2	37	2,457	175	811	1,89
Means:									
Number of beds	349	272	202	51	135	64	467	344	17
Total admissions	13,793	11,415	8,318	3,501	5,337	2,258	18,061	13,362	6,75
Occupancy rate	84%	76%	68%	116%	63%	49%	86%	76%	6
Average length of stay	7.8	6.7	6.0	5.9	6.2	5.4	8.2	7.4	6.
FTEs	1,499	831	557	582	371	145	2,138	1,186	50
Casemix Index	1.18	1.12	1.10	1.01	1.03	0.99	1.19	1.15	1.0
Cost per Medicare admission	$3,559	$2,531	$2,366	$1,270	$2,435	$1,912	$4,822	$3,563	$2,923
CMI-adjusted cost	$3,000	$2,243	$2,156	$1,260	$2,371	$1,917	$3,991	$3,101	$2,718
CMI and wage-adjusted cost	$3,448	$2,639	$2,478	$1,537	$2,664	$2,229	$3,441	$2,819	$2,517
Wage Index	.87	.85	.87	.82	.89	.86	1.16	1.10	1.08
% affiliated with Medical School	80%	72%	2%	0%	15%	*	89%	69%	3
% Members of COTH	80%	4%	0%	0%	0%	0%	79%	23%	*

[a]Categories for teaching status are:
Major teaching = at least .25 residents per bed.
Minor teaching = less than .25 residents per bed.
Non teaching = no residents.
*Less than 1%

Sources: Medicare Impact FY87 File, American Hospital Association 1985 Annual Survey of Hospitals.

TABLE 2-5

DESCRIPTIVE MEANS FOR LARGE TEACHING HOSPITALS DEFINED BY MEDICAL SCHOOL AFFILIATION/COTH MEMBERSHIP, 1984

	Rural Hospitals				Urban Hospitals			
	Non Teaching	Resident Program Only	Medical School Affiliation	Medical School and COTH	Non Teaching	Resident Program Only	Medical School Only	Medical School and COTH
Number of Hospitals	2,622	43	22	5	1,954	318	379	293
Means:								
Number of beds	71	155	241	376	171	254	347	514
Total admissions	2,587	6,546	9,515	14,940	6,749	7,987	13,908	19,958
Occupancy rate	50%	68%	73%	88%	65%	68%	78%	86%
Average length of stay	5.5	6.2	6.6	8.2	6.5	7.2	7.3	8.1
FTEs	167	467	660	1,663	505	677	1,193	2,141
Casemix Index	1.00	1.05	1.09	1.20	1.07	1.06	1.15	1.22
Cost per Medicare admission	$1,939	$2,413	$2,430	$3,766	$2,935	$3,584	$3,428	$4,450
CMI-adjusted cost	$1,932	$2,302	$2,219	$3,129	$2,729	$3,236	$2,976	$3,656
CMI and wage-adjusted cost	$2,247	$2,646	$2,580	$3,329	$2,550	$2,889	$2,756	$3,235
Wage Index	0.86	.87	.86	.94	1.07	1.12	1.08	1.13

Sources: Medicare Impact FY87 File, American Hospital Association 1985 Annual Survey of Hospitals.

residents to beds because of special programs.* These two hospitals are far less expensive per case than the 37 "minor" rural teaching hospitals that had virtually the same 1984 case mix and wage indexes. When both case mix and wages are adjusted for, major teaching RRCs are as costly per case as their urban counterparts. Minor rural teaching hospitals--whether RRCs or not--are slightly less costly per case than minor urban teaching hospitals.

Table 2-5 redefines rural and urban hospitals as teaching institutions according to their affiliation with a medical school or membership in COTH in addition to the presence of medical residents. By these definitions, major teaching hospitals are indeed more costly than nonteaching hospitals, even when case mix and wages are taken into account. Rural members of COTH are roughly 25 to 40 percent more costly than other rural teaching hospitals, even adjusting for case mix and wages. This is a far greater difference than is true for urban members of the COTH. These five hospitals are all RRCs. Analyses of their PPS revenues indicate that all fared well in 1984. From simulations it appears that four of the five would have received large surpluses had they been paid 100 percent the national urban rate.

Summarizing, rural teaching hospitals are more expensive than other rural hospitals, a fact that is addressed by the additional resident-per-bed add-on. Rural RRCs, on the other hand, are only somewhat more expensive than other rural hospitals, except for the two with major teaching status (as defined by residents per bed). These are less than half as costly per case as their RRC counterparts. Thus, teaching status is clearly an important characteristic to differentiate payment on, but not RRC or large rural teaching status in addition.

2.5 RRC Size

RRCs are much larger, on average, than other rural hospitals. Table 2-6 presents the mean number of beds, admissions, inpatient days, and full-time equivalent employees by hospital category. Because all of these characteristics are correlated with the number of discharges, one of the characteristics used to define RRCs, the difference between the rural

* Their small size gives rise to an average occupancy rate (inpatient days/beds) of 116 percent in 1984. Bedsize is measured at the end of the year while inpatient days are for the entire year. If a small hospital closes a few beds at the end of the year, its occupancy rate increases significantly.

TABLE 2-6

SIZE CHARACTERISTICS OF RRCs AND OTHER HOSPITALS, 1984

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Number of Hospitals Analyzed	168	2,996	2,884
Means:			
Total number of beds	217	65	239
Number of admissions			
All patients	8,957	2,301	9,380
Medicare patients	3,109	899	2,994
Number of Inpatient Days			
All patients	55,758	12,753	66,957
Medicare patients	22,266	5,551	23,775
Number of FTEs	627	148	802

Sources: Medicare Impact FY87, File American Hospital Association 1985 Annual Survey of Hospitals.

categories is to be expected.

RRCs have an average of 217 beds compared to 65 for other rural hospitals and 239 for urban hospitals. Other rural hospitals range in size from 6 beds to 395 but over half have fewer than 50 beds, see Figure 2-2. The frequency falls rapidly by numbers of beds, with only 2 percent of other rural hospitals having over 200 beds. By comparison, only 1 percent of RRCs have fewer than 100 beds and the largest one has 641 beds. Half of the RRCs had between 150 and 300 beds in 1984. The distribution drops off markedly above 300 and less than 4 percent of RRCs are larger than 400 beds. This also contrasts sharply with urban hospitals which range in size from 6 to almost 2,000 beds with 16 percent falling in the "large" category of more than 400 beds. The distribution of urban hospitals by bed size is much more even than either of the others, with modes of 51-100 and 201-300 beds. (See Figure 2-2A for a graph of the three groups by bedsize.) This difference in distribution is to be expected because the RRC category is defined to include many of the largest rural hospitals.

The difference between RRCs and other rural hospitals is even greater for size characteristics other than number of beds. RRCs have 3.4 times more beds, but they have almost four times the number of admissions and four and one-half times more inpatient days. This is reflected in longer lengths of stay and higher occupancy rates for RRCs, as shown in section 2.6. It is also reflected in the fact that RRCs had 4.2 times as many Full Time Equivalents (FTEs) as other rural hospitals.

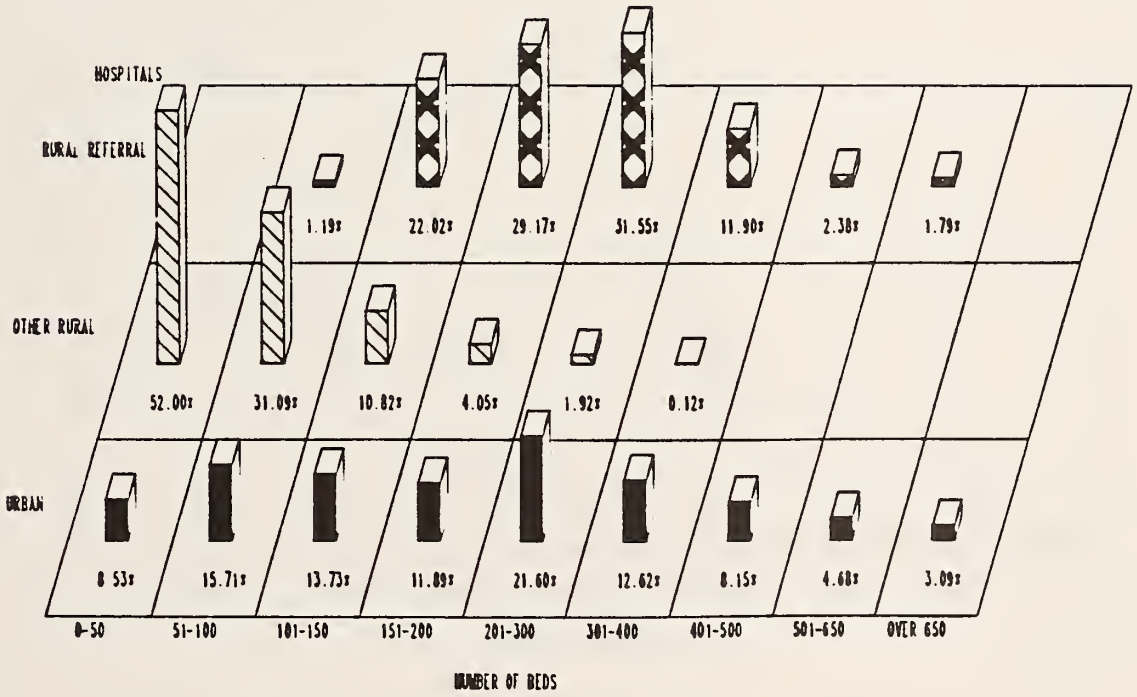
Comparing RRCs with urban hospitals, we find that the average RRC bed size is only about 10 percent smaller than the average urban hospital's. This again reflects the fact that the discharge criterion for designating RRCs is set at or just below the median number of discharges for urban hospitals. Nevertheless, the average RRC admits only 5 percent fewer patients, keeps them a shorter time, and uses significantly fewer workers (627 vs. 802) to attend them. Some of these differences stand out in Table 2-7 which presents data on rates of utilization.

2.6 RRC Utilization

There are significant differences in rates of utilization between types of hospitals. For RRCs, the mean length of stay (LOS), overall, is 6.1 days. This is over half a day longer than in other rural hospitals, but about three quarters of a day shorter than in urban areas.

FIGURE 2-2

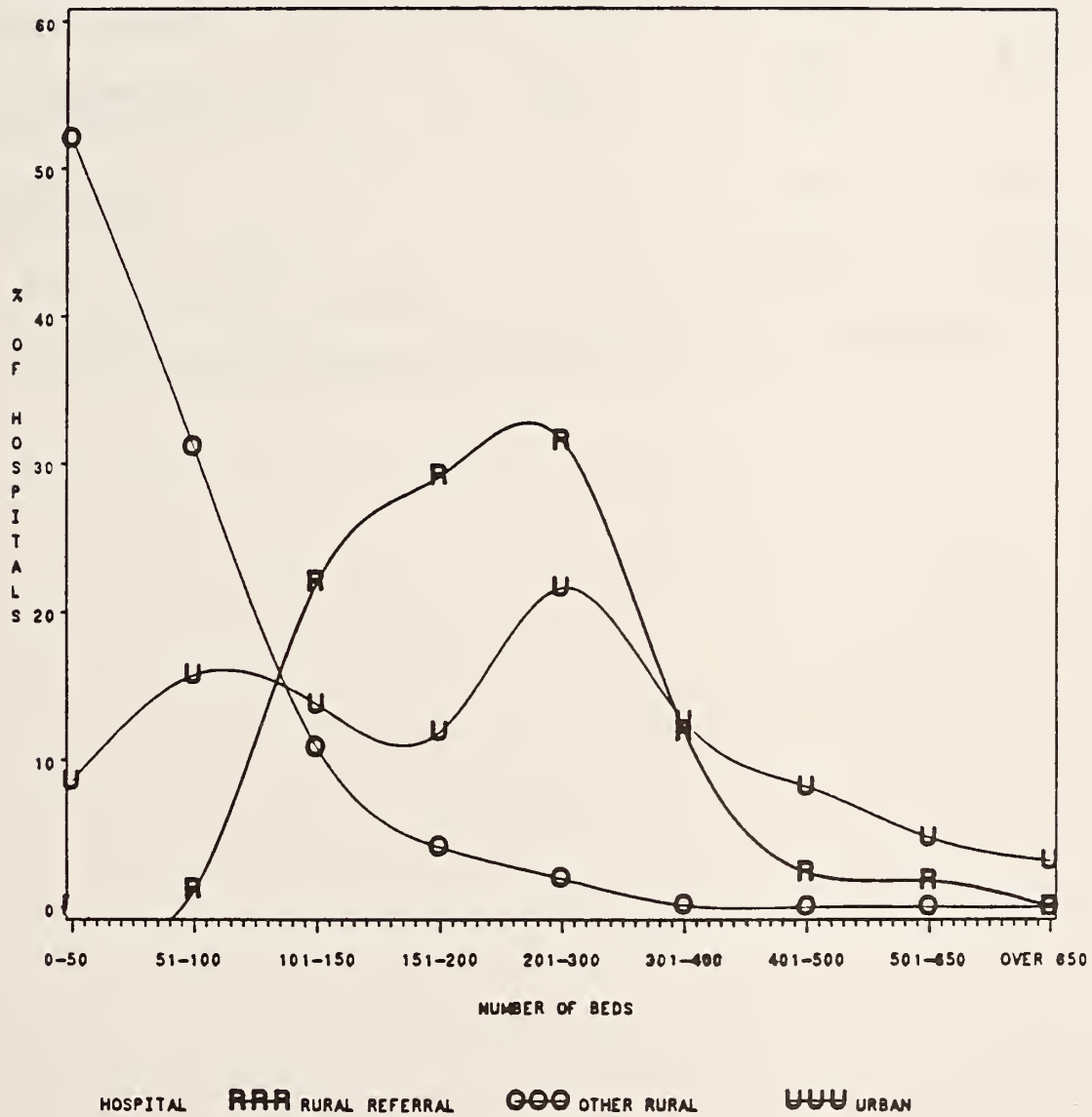
DISTRIBUTION OF HOSPITALS BY TOTAL NUMBER OF BEDS, 1984



SOURCE: MEDICARE IMPACT FILE

FIGURE 2-2A

DISTRIBUTION OF HOSPITALS BY TOTAL NUMBER OF BEDS, 1984



SOURCE: MEDICARE IMPACT FILE

TABLE 2-7

AVERAGE UTILIZATION IN RRCs vs. OTHER HOSPITALS, 1984

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Number of Hospitals Analyzed	168	2,496	2,884
Length of Stay - All Patients	6.1	5.4	6.9
Occupancy Rate-Overall	70%	49%	77%
Number of Surgical Operations	5,231	959	5,638
Surgeries/Admission	0.58	0.34	0.59
Number of visits to Emergency Room	17,112	4,944	19,333
Number of outpatient visits	45,376	12,078	58,058

Sources: American Hospital Association 1985 Annual Survey of Hospitals.

The reasons for these LOS differences are varied. The LOS should depend in large part on the severity of the patient's condition. RRCs have higher case mix indexes (see Table 2-8) indicating cases in more severe DRGs that require longer stays. The average urban hospital on the other hand, does not have a higher CMI than RRCs, and so that cannot explain the longer LOS in urban areas. An additional explanation has to do with differences in medical practice across regions. We have already noted that RRCs are disproportionately in the South, while urban hospitals are more likely to be in the Northeast. Average LOS, holding case mix constant, tends to be longer in the New England and Mid-Atlantic States where urban hospitals are concentrated, and shorter in the South (Chassin, 1983).

The other rates of utilization given in Table 2-7 show just how busy RRCs are (an impression reinforced by our case studies). The average RRC performs almost as many surgeries as an urban hospital and more than five times as many as the typical rural hospital. RRC surgery rates are also higher (58 percent vs. 34 percent) than in other rural hospitals. Finally, RRCs' emergency rooms and outpatient departments are only slightly less busy than urban hospitals and several times the size of other rural hospitals.

2.7 RRC Case Mix Severity and Scope of Services

The rates of utilization in Table 2-7 suggest that the severity of cases should differ across hospital groups. Table 2-8 presents the mean case mix index plus information on the scope of services offered in each hospital category. RRCs have a mean 1984 case mix index of 1.11, compared to 1.00 for other rural. This implies that RRC patients are 11 percent more costly on average than those in the typical rural hospital. The difference between the types of rural hospitals is in keeping with the longer LOS for RRCs because the mean urban case mix index is also 1.11. However, case severity across DRG categories cannot account for the longer stays in urban hospitals than in RRCs.

More severe cases should lead to a broader scope of services being offered. Table 2-8 lists 18 major hospital services and the percentage of hospitals offering each one. For almost every type of service, a greater proportion of RRCs provide it compared to urban hospitals. The differences are most pronounced for therapeutic radioisotopes (54 percent vs. 6 percent),

TABLE 2-8

HOSPITAL CASE SEVERITY AND SCOPE OF SERVICES BY RRCs vs. OTHER HOSPITALS, 1984

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Number of Hospitals Analyzed	168	2,496	2,884
Means:			
Case Mix Index	1.11	1.00	1.11
Percent of hospitals with the following services:			
Blood bank	87%	66%	80%
Diagnostic radioisotope facility	96	48	86
Therapeutic radioisotope	54	6	40
Emergency Department	100	98	95
Family planning	4	4	18
Hemodialysis-inpatient	41	5	44
Histopathology lab	91	41	87
Home Care	33	18	26
Outpatient department	48	32	62
Open heart surgery	9	*	22
Organ bank	4	*	8
Premature nursery	66	14	42
Psychiatric Emer. Serv.	63	15	44
Physical Therapy	99	83	97
Rehab-outpatient	45	17	51
Respiratory therapy	100	90	98
Social work dept.	96	63	93
X-ray therapy	39	4	29

*Less than 1%

Sources: Medicare Impact FY87 File, American Hospital Association 1985 Annual Survey of Hospitals.

6 percent), hemodialysis (41 percent vs. 5 percent), histopathology lab (91 percent vs. 41 percent), premature nursery (66 percent vs. 14 percent), and X-ray therapy (39 percent vs. 4 percent). This difference reflects that the mean urban hospital is not the appropriate reference group for RRCs, which are selected as tertiary care centers.

However, a larger proportion of urban hospitals provide the following services compared to RRCs: family planning, inpatient hemodialysis, outpatient services, open heart surgery, organ banks, and outpatient rehabilitation. Burn care units (not shown on the table) are also concentrated in urban areas. These differences may reflect the fact that services such as burn care and organ transplants take place primarily in regional referral hospitals located in urban centers.

2.8 Average RRC Costs

The average small rural hospital with 65 beds had operating costs (including depreciation and interest) of just under $5 million dollars a year in 1984 (see Table 2-9). With an average of 2,300 inpatients, and 12,000 outpatient visits, this means costs per adjusted admission are $1,779. The average RRC handles almost four times as many patients (both inpatient and outpatient) each year and has total costs that are also roughly four times greater. These costs average $2,198 per adjusted patient, $400 more than for small rural hospitals, but this is accounted for primarily by LOS, which is 0.7 day longer in RRCs. The cost per day is only $17 more in RRCs ($351 vs. $334). Urban hospitals, with slightly more inpatients and over 25 percent more outpatients on average, have 1984 costs per adjusted admission that are 36 percent greater than RRC costs ($2,994 per adjusted admission). Even on a daily rate (to allow for the longer stays in urban hospitals) costs are 24 percent more ($435 vs. $351).

One reason for the differences in costs among the three types of hospitals is suggested by the average salaries per FTE, which are $2,200 greater in urban hospitals than in RRCs but $1,900 less in other rural hospitals. On a per case basis, RRCs pay an average of $1,021 in salaries per patient. This is 46 percent of the total cost per patient. Other rural hospitals pay less in salaries per patient ($830), but this represents 47 percent of their total patient costs. Urban hospitals are highest with $1,352 in salaries per patient, but this also comprises only 44 percent of their

TABLE 2-9

AVERAGE COSTS FOR ALL PATIENTS, BY RRCs vs. OTHER HOSPITALS, 1984

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Number of Hospitals Analyzed	168	2,496	2,884
Means:			
Cost per hospital (000's)	$23,285	$ 4,981	$35,159
Cost per adjusted admission	2,198	1,779	2,994
Cost per adjusted day	351	334	435
Average salary per FTE	$17,217	$15,316	$19,440
FTE per patient	0.06	0.06	0.07
Average salary per Patient	$1,021	$ 830	$1,352
Salary as percent of cost per admission	46%	47%	45%
Federal wage index	.87	.86	1.08

Sources: Medicare Impact FY87 File, and American Hospital Association 1985 Annual Survey of Hospitals.

total patient costs. (Salary differences and the occupational mix of workers are the subject of Chapter 4.)

Figures 2-3 and 2-3A show the distributions of hospitals by cost per admission. These costs are adjusted for outpatient visits but are unadjusted for differences in case mix, wages, or teaching status. The major differences among the three hospital groups are apparent. RRCs' higher average cost per adjusted admission means that a greater proportion of RRCs fall into the higher cost cells. However, the general shapes of the two rural distribution curves are very similar, especially when contrasted with the distribution of urban hospitals. Over 35 percent of the latter have costs above $3,400 per adjusted admission compared to only 5.5 percent of RRCs and 2.3 percent of other rural hospitals. However, this greater proportion is undoubtedly related to the higher wages, case mix measures and teaching activities in urban areas.

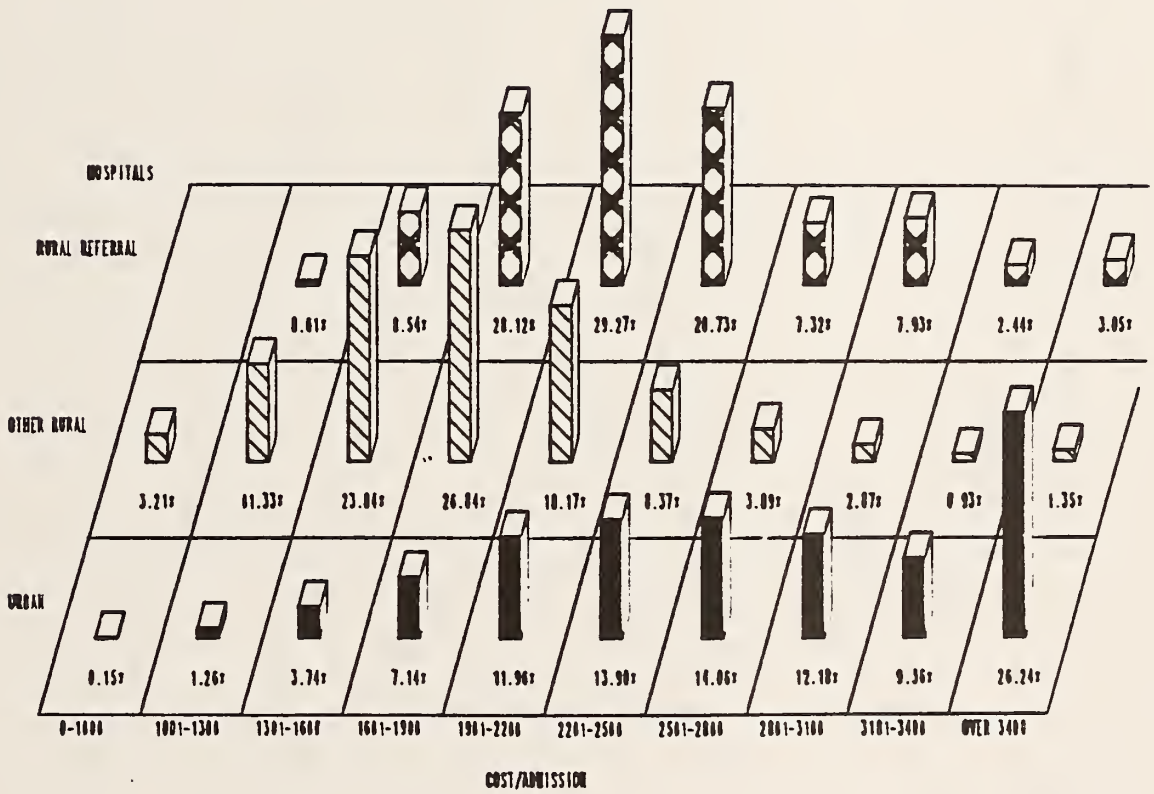
When the differences in LOS are taken into account (see Figures 2-4 and 2-4A), a greater proportion of RRCs than other rural hospitals fall into the $251-400 range. Urban hospitals remain more costly on a per adjusted day basis than rural hospitals but, again, the costs are unadjusted for various factors. This adjustment will be the subject of Chapter 3.

Hospital cost patterns differ between urban and rural hospitals, as shown in figures 2-3, 2-3A, 2-4 and 2-4A. These differences occur for a variety of reasons, including but not limited to: case mix, occupancy levels and stability, area labor market conditions, service variety and capacity, teaching activity, admission threshold policies, availability of alternative treatment facilities, etc.* Because of the large number of influences upon hospital costs, it is not surprising that any broad categorization of hospitals--such as "urban" versus "rural"--also produces substantial overlaps in cost per day on cost per case distributions. However, it is also clear that large difference in average costs exist between the average urban hospital and the average rural hospital and also between the average urban hospital and the average RRC.

*The regression analyses presented in Chapter 3 of this report study the major influences on RRC costs. Further research is continuing to study many other factors and the results will be discussed in a separate DHHS report entitled, "Studies of Urban-Rural and Related Geographical Adjustments in the Medicare Prospective Payment System."

FIGURE 2-3

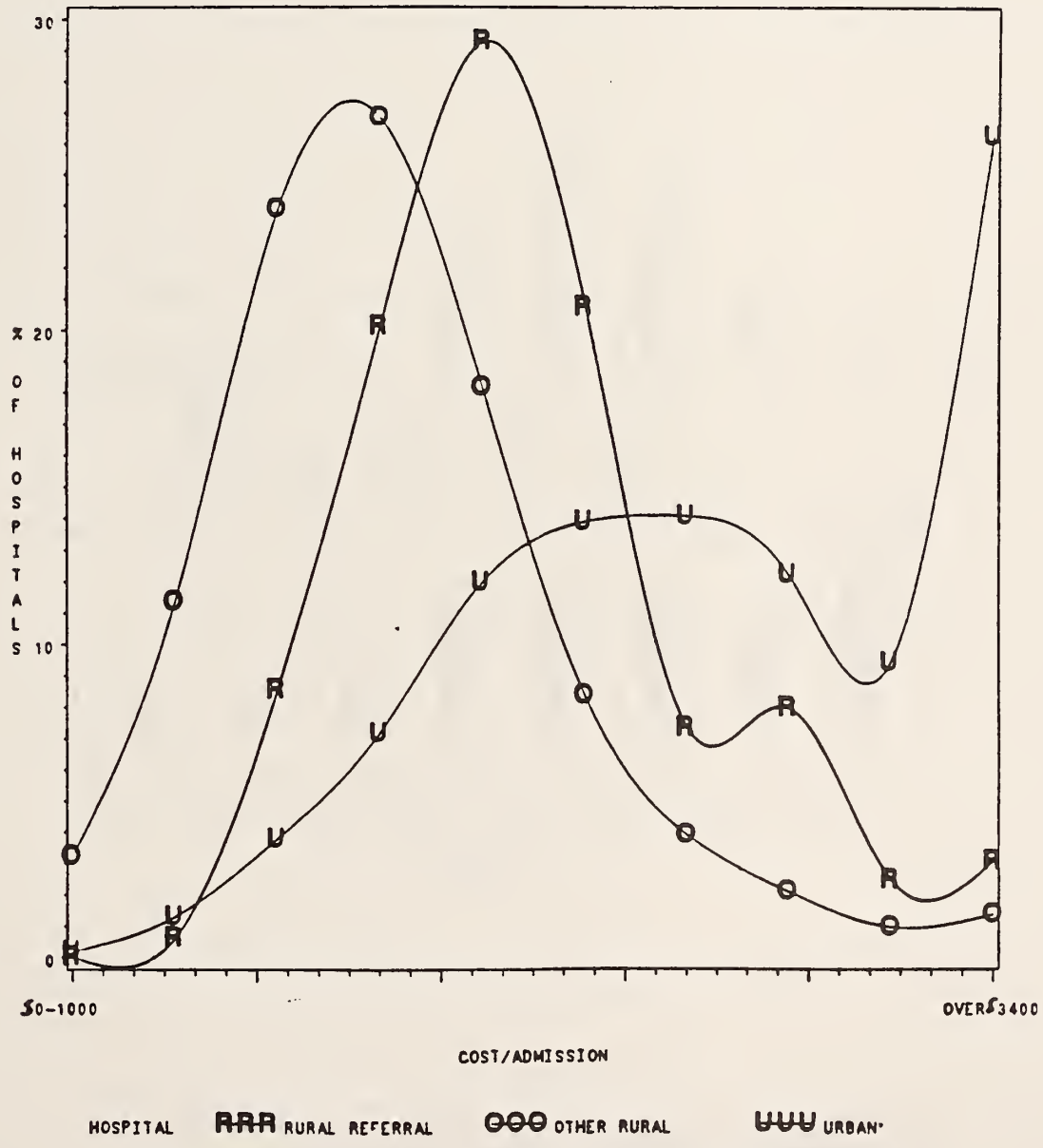
DISTRIBUTION OF HOSPITALS BY COST PER ADJUSTED ADMISSION, 1984



SOURCE: AHA 1985 ANNUAL SURVEY OF HOSPITALS

FIGURE 2-3A

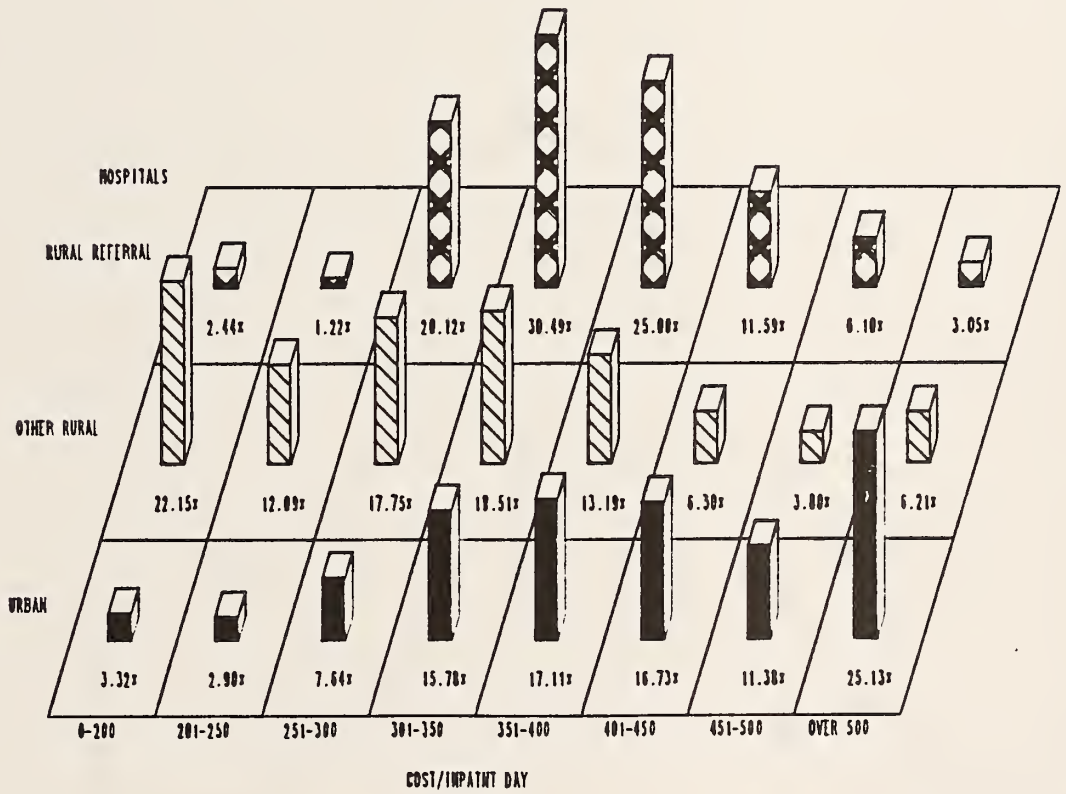
DISTRIBUTION OF HOSPITALS BY COST PER ADJUSTED ADMISSION, 1984



SOURCE: AHA 1985 ANNUAL SURVEY OF HOSPITALS

FIGURE 2-4

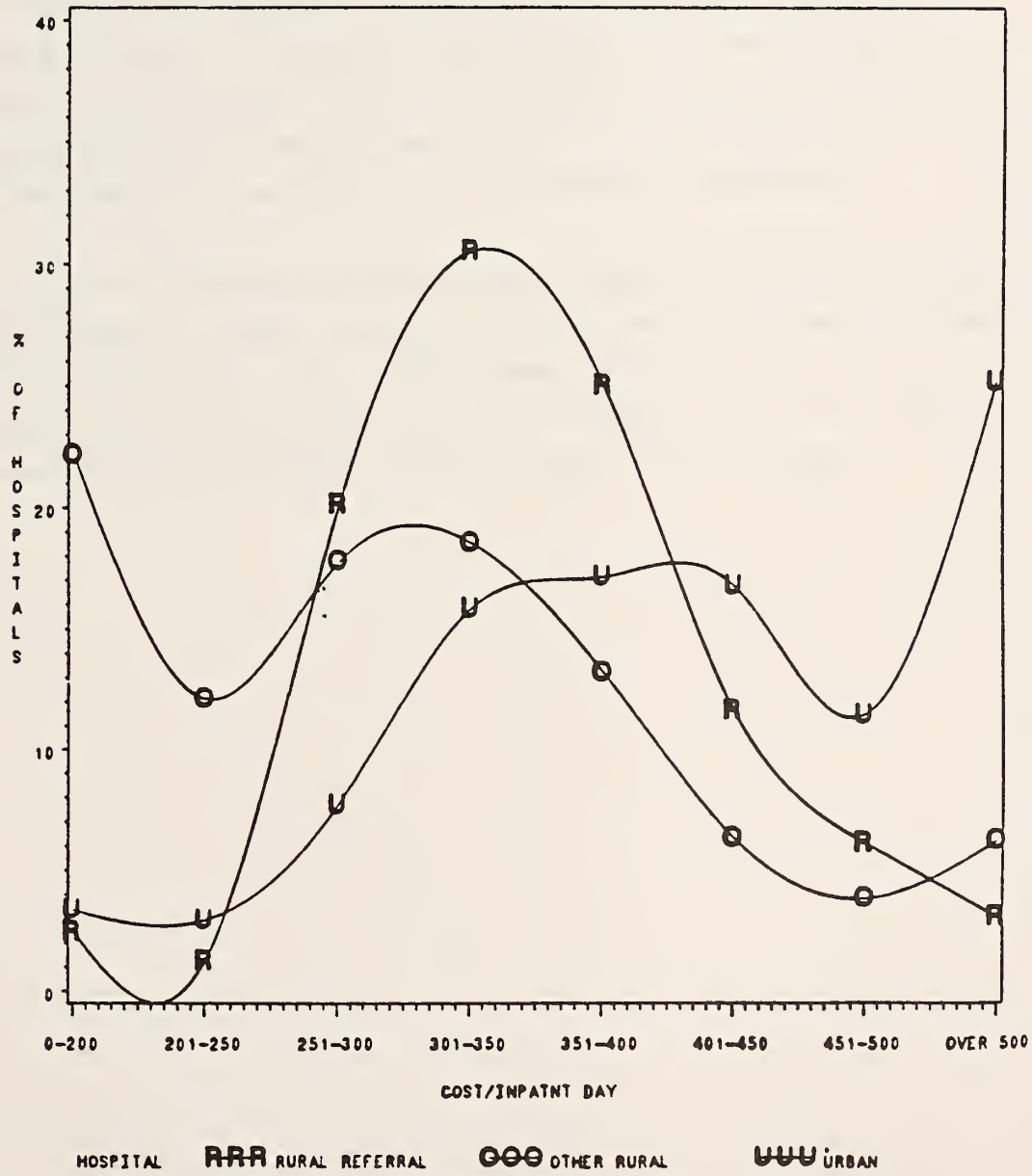
DISTRIBUTION OF HOSPITALS BY COST PER ADJUSTED INPATIENT DAY, 1984



SOURCE: AHA 1985 ANNUAL SURVEY OF HOSPITALS

FIGURE 2-4A

DISTRIBUTION OF HOSPITALS BY COST PER ADJUSTED INPATIENT DAY, 1984



SOURCE: AHA 1985 ANNUAL SURVEY OF HOSPITALS

2.9 RRC Medicare Average Costs and Utilization

The aggregate picture in Section 2.8 may be misleading. Cost differences for Medicare patients should also be examined. After all, the DRG payments apply to Medicare patients. If costs per Medicare admission differ markedly between types of rural hospitals, those with the higher average will lose under PPS even if their overall costs are not greater.

Medicare admissions are 35 percent of the patients in RRCs (Table 2-10). This is about the same as in urban hospitals (34 percent) but much less than in other rural hospitals (41 percent). However, Medicare patients cost more on average than other patients (e.g., $2,426 vs. $2,198 for RRCs) so the hospitals' dependency on Medicare is somewhat more than the number of admissions would indicate. It should be kept in mind that the costs per Medicare admission do not include capital costs (depreciation and interest), which are currently paid as a pass-through under PPS. Therefore, the difference between Medicare costs and overall costs per admission are understated.

Comparing costs per Medicare patient across hospital categories, we find that RRC Medicare costs are $500 more than those for other rural hospitals and $783 less than in urban areas. When LOS is taken into account, the ranking remains stable, although the differences in dollar amounts are not as great (only $150 a day difference between urban and small rural hospitals).

TABLE 2-10

AVERAGE COSTS AND STAYS FOR MEDICARE PATIENTS, 1984

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Number of Hospitals Analyzed	168	2,496	2,884
Means:			
Percent of admissions that are Medicare patients	35%	41%	34%
Average cost per patient	$2,426	$1,920	$3,219
Average cost per day	$384	$315	$463
Average length of stay (days)	7.6	6.3	8.2
Percent of all Medicare admissions*	5.0%	20.0%	75.0%
Percent of all Medicare hospital costs*	4.0	13.0	83.0

*These figures can only be approximations because of the absence of outpatient cost data and the separate reimbursement of physicians.

Sources: Medicare Impact FY87 File

Figures 2-5 and 2-6 reinforce the finding that RRCs have higher Medicare costs on average compared to other rural hospitals but that much of this is related to longer LOS. For example, two-thirds of the RRCs have costs per Medicare admission above $2200 versus about one-quarter of smaller rural hospitals. However, on a per day basis, 90 percent of RRCs have costs greater than $250 vs. about 75 percent of other rural hospitals. Neither group appears to be as costly, on an unadjusted basis, as the urban hospital category.

Medicare rates play a very large role in the financing of rural hospitals. Two additional percentages in Table 2-10 show the role of these hospitals in PPS. RRCs treat 5 percent of all the Medicare inpatients under PPS but account for only 4 percent of the total hospital costs of Medicare. Other rural hospitals treat 20 percent of the patients for only 13 percent of all costs. Urban hospitals with 75 percent of the Medicare inpatients are much more costly than either type of rural hospital even when case mix differences and wages are taken into effect and so account for about 83 percent of all Medicare inpatient expenditures.

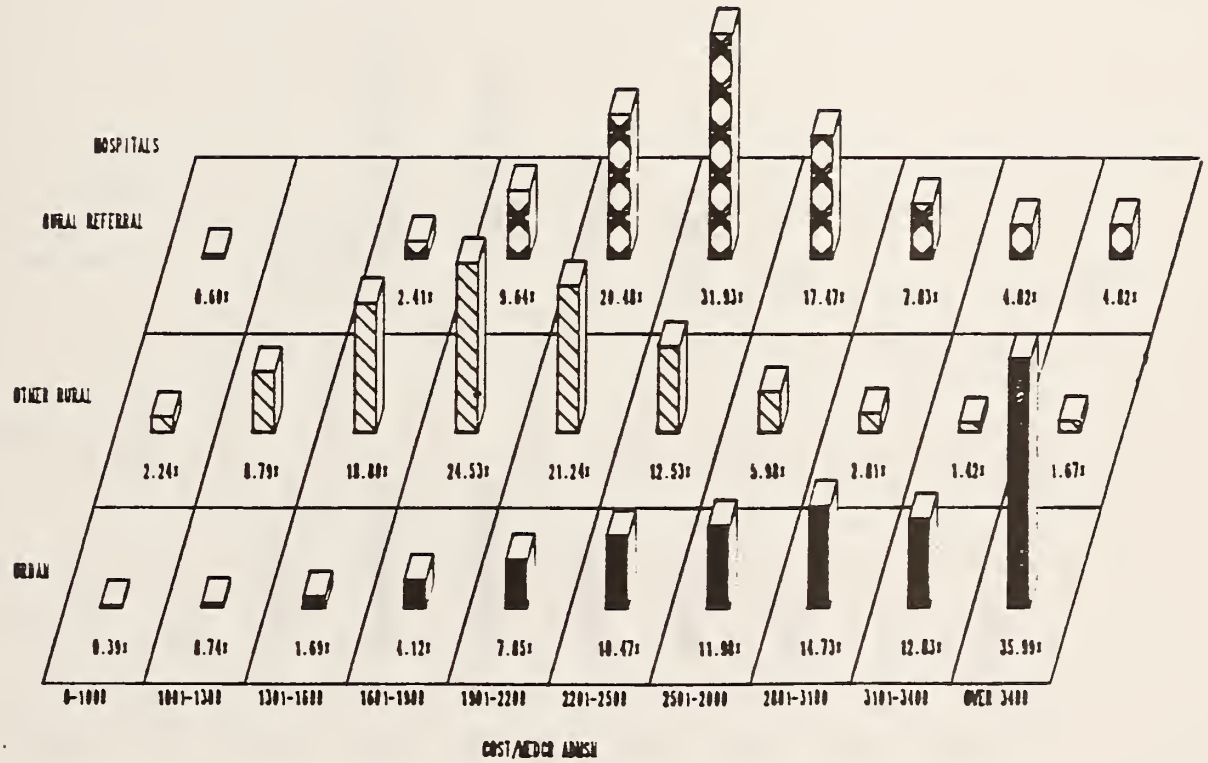
2.10 RRC Differences Across Regions

In section 2.2, the concentration of RRCs in the eastern and southern areas of the country was pointed out. Geographic location may be very important in analyzing cost differences because wages, medical practices, regulatory programs, and malpractice costs vary widely across States. This was explicitly recognized by Congress in mandating alternative regional criteria for RRC designation.

Table 2-11 presents both adjusted and unadjusted cost data for comparisons of RRCs and other rural hospitals across regions. In every region except the Pacific, unadjusted costs per admission are higher for RRCs than for other rural hospitals. Pacific RRCs are less expensive on average.

FIGURE 2-5

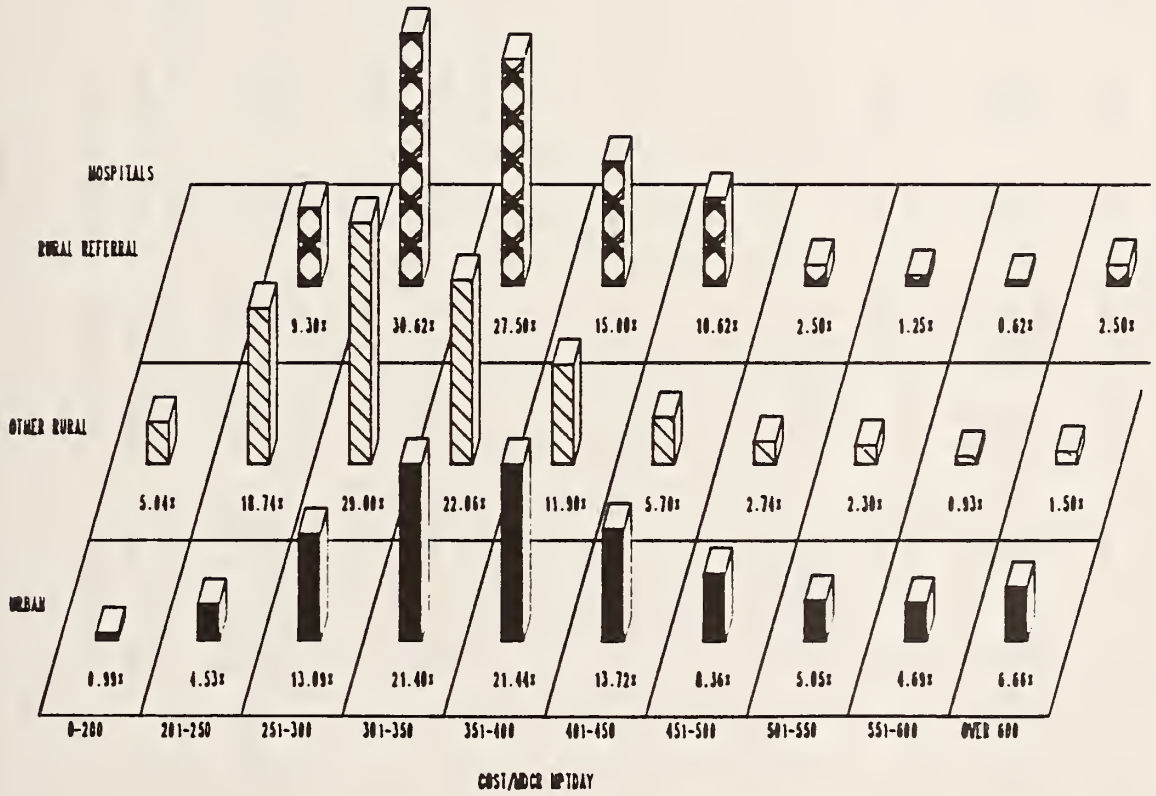
DISTRIBUTION OF HOSPITALS BY COST PER MEDICARE ADMISSION, 1984



SOURCE: MEDICARE IMPACT FILE

FIGURE 2-6

DISTRIBUTION OF HOSPITALS BY COST PER MEDICARE INPATIENT DAY, 1984



SOURCE: MEDICARE IMPACT FILE

TABLE 2-11

REGIONAL VARIATIONS IN RURAL HOSPITALS CHARACTERISTICS AND COSTS, 1984

	New England		Mid-Atlantic		South-Atlantic		East North Central		East South Central	
	RRC	Rural	RRC	Rural	RRC	Rural	RRC	Rural	RRC	Rural
Means:										
Casemix Index	1.13	1.04	1.12	1.00	1.11	1.01	1.10	1.01	1.07	.97
Length of Stay (days)	6.8	5.5	7.5	7.4	6.4	5.7	6.4	5.6	6.3	5.4
Cost per admission	$3,068	$2,849	$3,556	$2,538	$2,407	$2,076	$2,813	$2,332	$2,191	$1,770
Cost per day	$ 449	515	468	357	372	372	441	423	349	333
Adjusted cost per admission	2,706	2,737	3,169	2,542	2,155	2,053	2,545	2,308	2,034	1,831
Adjusted cost per day	398	495	418	357	334	369	400	481	325	344

	West North Central		West South Central		Mountain		Pacific	
	RRC	Rural	RRC	Rural	RRC	Rural	RRC	Rural
Means:								
Casemix Index	1.11	1.00	1.08	0.97	1.13	.99	1.14	1.03
Length of Stay (days)	6.1	5.7	5.5	5.3	5.2	4.5	4.8	4.4
Cost per admission	$2,660	$2,105	$2,086	$1,845	$2,743	$2,390	$2,668	$3,103
Cost per day	437	392	378	365	531	566	551	737
Adjusted cost per admission	2,417	2,100	1,937	1,909	2,443	2,401	2,354	3,008
Adjusted cost per day	398	392	352	379	470	571	486	721

Sources: Medicare Impact FY87 File, American Hospital Association 1985 Annual Survey of Hospitals, and Area Resource File.

This is due to the fact that California is more costly and has only one RRC but a disproportionate number of other rural hospitals. The RRC/other rural cost difference in the Pacific is largely a State phenomenon.

When costs are adjusted for case mix, the difference in the Pacific region grows. In the other regions, the difference is reduced so that RRCs are more expensive by only $30 to $600, on average. However, this is generally related to the longer LOS in RRCs and, on a per day, basis the RRCs are generally less costly. An analysis holding region constant is presented in Chapter 3.0.

2.11 A Comparison of Rural Hospitals, 1981 to 1984

The analysis of costs reported in Chapter 3 uses data from FY 1984, the first year of PPS. Not all hospitals were reimbursed under PPS for all 12 months of this period because their entries were staggered according to the start of their fiscal years following October 1, 1983. Nevertheless, it is interesting to compare figures for 1984 with those of 1981, the base year for many of the criteria for qualification as an RRC. Table 2-12 presents mean values for RRCs and other rural hospitals for both years and the mean percentage change between the 2 years.

Inspection of Table 2-12 reinforces the image of RRCs as being different from other rural hospitals. In 1981, they were even larger, more costly per Medicare case, and had even longer LOS than other rural hospitals. In the 3 intervening years, they changed more than other rural hospitals in three crucial respects: they reduced their bed size more, they kept their occupancy rates from falling as fast (in large part because they increased Medicare admissions more), and they did not increase costs per Medicare admission as rapidly as other rural hospitals did.

Perhaps the major unexpected changes documented for both RRCs and urban hospitals are the decrease in overall admissions accompanied by an increase in Medicare admissions. The increase in Medicare admissions is in keeping with aggregate HCFA data showing increases in total Medicare admissions between 1981 and 1983 and a decrease between 1983 and 1984. The net effect of these two changes is an overall increase between 1981 and 1984.

However, the 1983-84 decrease in Medicare admissions appears to have been preceded by decreases in non-Medicare admissions in all hospital categories in the previous years.

TABLE 2-12

RRC AND OTHER HOSPITALS, 1981 TO 1984[a]

Means and Mean Percentage Changes in:	RRCs 1981	RRCs 1984	Other Rural 1981	Other Rural 1984	Urban Hospitals 1981	Urban Hospitals 1984
Bedsize	225	218 (-2.5%)	66	65 (-0.5%)	253	242 (-1.3%)
Number of Admissions						
All Patients	9,515	9,088 (-4.0)	2,556	2,346 (-8.6)	9,817	9,527 (-4.0)
Medicare Patient	2,875	2,945 (+2.4)	867	831 (-4.6)	2,773	2,885 (+5.4)
Number of Inpatient Days						
All Patients	63,966	56,455 (-10.5)	17,933	12,992 (-22.8)	75,851	68,160 (-11.3)
Medicare Patients	26,984	22,619 (-16.1)	7,253	5,558 (-25.6)	29,101	24,681 (-14.2)
Length of Stay (Days)						
All Patients	6.6	6.1 (-6.8)	7.8	5.4 (-15.5)	7.7	6.8 (-7.3)
Medicare Patient	9.4	7.7 (-17.0)	8.0	6.3 (-19.8)	10.1	8.2 (-17.4)
Occupancy Rate	74%	70% (-4.7)	55%	49% (-8.7)	72%	69% (-4.0)
Case Mix Index	1.05	1.11 (+5.5)	0.95	1.00 (+4.9)	1.04	1.11 (+5.8)
Total Cost (000's)	$17,306	$23,466 (+34.8)	$4,222	$5,475 (+29.4)	$28,028	$37,646 (+35.0)
Cost per Admission						
Adjusted Total Patients[b]	$1,596	$2,198 (+38.5)	$1,313	$1,779 (+38.1)	$2,196	$2,994 (+38.8)
Medicare Patients	$2,083	$2,410 (+17.1)	$1,594	$1,942 (+25.9)	$2,836	$3,217 (+17.6)
Cost per Day						
Adjusted Total Patients[c]	$243	$351 (+45.7)	$226	$334 (+50.2)	$301	$435 (+46.7)
Medicare Patients	$228	$359 (+59.9)	$197	$315 (+62.6)	$275	$456 (+64.9)

[a]The same hospitals are represented for both 1981 and 1984 data for each measure.
[b]Cost per adjusted total patients was calculated by dividing the AHA measure for total hospital expenditures (including outpatient but not nursing home costs) by the AHA's "Adjusted Admissions" which adjusts outpatient visits by the ratio of outpatient revenue per visit to inpatient revenue per day and adds them to inpatient admissions.
[c]Cost per adjusted day was calculated by dividing the AHA total expenditures by AHA adjusted days.

The impact of these declines differ across groups of hospitals, however, according to how much they succeeded in an offsetting increase in Medicare admissions during 1981 and 1982. For example, RRCs suffered only a 4-5 percent decrease in average occupancy rates and held the increase in costs per admission and per day to the same rate of increase as other rural hospitals (38 percent for adjusted admissions) except for costs per Medicare admissions (17 percent vs. 26 percent).

These changes suggest that RRCs may have been quicker in responding to the changing economic conditions of the early 1980s. On the other hand, it may also point to the importance of size: larger, tertiary hospitals may not suffer as much from fluctuations in demand as do smaller hospitals.

When both groups of rural hospitals are contrasted with urban hospitals, we find that the latter did half as well as RRCs at shrinking bedsize (down 1.3 percent) and about as well at offsetting losses of non-Medicare admissions with Medicare increases in 1981 and 1982 (a net loss of only 4.0 percent on average). Urban hospials also fared about the same as RRCs in reducing Medicare LOS (down 17 percent for each group), losing only 4.0 percent occupancy and holding down the increases in both Medicare and overall costs per admission (18 percent and 39 percent respectively) although on a per day basis, urban Medicare costs grew somewhat faster than rural costs while non-Medicare costs did not. These last differences are due largely to the differential shortening of Medicare and non-Medicare LOS. Medicare stays were shortened more, so the cost per day rose faster.

2.12 Summary

In both 1981 and 1984, RRCs were larger than other rural hospitals with longer Medicare LOS and more severe case mixes. They were also more likely to be teaching institutions, although the majority did not offer residencies. They had larger facilities, offered more services, and paid higher wages per worker. It is not surprising, then, that RRCs' costs per admission were greater than other rural hospitals' costs. This difference held across Census divisions and so is not an artifact of location in more costly areas of the country.

On the other hand, while RRCs are almost as big and as busy as the average urban hospital, they are not as costly, either per admission or per day. Urban hospitals were $800 more costly than RRCs per Medicare admission in 1984, and $1,300 more costly than other rural hospitals. However, these figures are not adjusted for cost factors recognized by PPS, such as differential wages, teaching, etc. Therefore, let us turn to an analysis that controls for these factors to answer the questions posed in Section 1.4:

1. Are RRCs' costs higher than those of other rural hospitals?

2. If their costs are not higher on average, is there a subset of rural hospitals whose costs are higher (requiring a redefinition of rural centers)?

3. What are the sources of any differences in hospital costs? That is, can they be explained by the hospital's case mix index alone or are other factors also important?

4. Are RRC costs "similar" to the costs of urban hospitals? What does "similar" mean?

5. What payment rate is appropriate for RRCs?

3.0 DO RRCs HAVE HIGHER COSTS?

3.1 Introduction

The purpose of designating RRCs is to "take account of their special needs" in order to pay them adequately for their supposedly higher than average Medicare costs. There are a number of causes that have been suggested for higher costs. RRCs supposedly treat the "sickest" patients. Therefore, they must have special equipment and facilities which are very costly. These special facilities require more highly skilled workers who have to be hired away from urban hospitals for wages that are above the rural average. In addition, their referral cases are likely to be the most severe cases within each DRG category, contributing to higher costs. Finally, the fixed stand-by costs of the special equipment may be spread over fewer cases than in urban referral centers, raising average costs.

All of these could be legitimate reasons to give RRCs higher base payment rates. However, in Chapter Two, we discussed reasons for higher costs that already justify higher payments (but not higher base rates) under PPS. For example, costs could be higher because RRCs treat more cases with high DRG weights than other rural hospitals. This would be reflected in higher case mix indexes and would be automatically covered by DRG-specific payments. A teaching hospital should also have higher than average costs because of the need for additional tests and medical supplies in training interns and residents. However, these costs are covered by a special add-on to the Medicare reimbursement and so would not justify a higher base rate. The analysis must distinguish these causes from all the other reasons for higher costs per case.

The main technique used to isolate these sources of higher RRC costs that are already covered under PPS is multivariate regression. Regression analysis is a statistical technique that allows causal factors to be "held constant" so that only differences of particular interest are reflected in the coefficients. The task is to specify the right variables to hold constant so that the coefficients for RRCs, other rural hospitals, and urban hospitals can be interpreted appropriately. In Section 3.2, the rationale for the regressions in this study is explained. Section 3.3 sets forth the empirical results and Section 3.4 summarizes the findings.

3.2 Regression Specification

Multivariate regression is a standard technique for testing hypotheses about specific parameters (e.g., the type of hospital) while accounting for other factors (e.g., area wage differences, complexity of cases, or teaching status) that also influence the dependent variable (cost per case). The regressions in this study raise a number of important issues. Understanding these issues requires a discussion of the sources of potential weaknesses in a regression. This background is provided in sections 3.2.1 and 3.2.2.

3.2.1 Regression Models

In economic theory, costs are a function of a firm's output and its input prices. This is sometimes written as:

$$AC = f(Q;P) + e \qquad (3\text{-}1)$$

where

AC = average cost,
Q = the multiple outputs of the firm: $(q_1, q_2, \ldots q_j)$
P = price of the i-th inputs: $(p_1, p_2, \ldots p_i)$
e = random differences in costs.

The relationship of output costs to relative input prices appears direct: if input prices are higher in one area than another, the cost should be higher in the high-priced area unless the producer can substitute relatively cheaper inputs for those that are relatively more costly. It is generally assumed that hospitals cannot easily substitute labor for nonlabor inputs. Types of labor are also not easily substituted because of specialization. Janitors cannot be nurses. Therefore, costs should rise in fairly direct proportion with wages and the prices of supplies and materials.

The relationship of average costs to the quantity of outputs is not as simple. In a simple economic cost function with a homogeneous product, average costs are assumed to fall, remain constant and then rise as the

quantity of output increases. These three areas of the average cost curve reflect the existence of economics of scale at first (as the firm moves to a minimum efficient scale of production), constant returns to scale, and finally diseconomics of scale (as the firm exceeds the efficient size or range). If the output is not homogeneous but rather encompasses a multitude of different products (as health care does) then an estimation of a simple cost function may show constantly rising average costs. This could be erroneously interpreted as proof of diseconomies existing in any but the smallest firms when in fact the rising costs may be a direct result of producing more complex, and therefore more costly, products in a larger hospitals. Therefore, it is important to distinguish the effects of producing a greater scale of output from the effects of producing a greater scope or diversity of products.

This difference in scale versus scope is easily illustrated for hospitals. The average cost for large hospitals is generally higher than for small ones. Much of this can be attributed to the fact that burn care, organ transplants, open heart surgery and the like occur primarily in the larger institutions. Therefore, the mix of cases is more costly in large hospitals and may more than offset any cost savings from the larger scale, if the latter exist. Further, hospitals also produce medical education through the training of medical residents. This may add to costs irrespective of the mix or number of patient cases.

For these reasons, it is important to hold the mix of products constant in estimating hospital costs. PPS measures these differences in scope through a case mix index that captures cost differences across diagnostic groups, through an outlier adjustment for the most severe cases within DRGs, and a measure of indirect medical education costs based on the number of medical residents per hospital bed.

There are two simple ways to measure and include quantity in the cost function. The first is to use the number of patient days or admissions. The second is to include the number of hospital beds, which is highly correlated with admissions and days. The second way (including number of hospital beds) is commonly used by HCFA when estimating the indirect costs of medical education. However, no adjustment is made for diseconomies of scale measured in this manner. HCFA's explicit policy is not to pay for beds, with the rationale that a payment set without respect to size gives hospitals an incentive to change to a more efficient size.

Economic costs should include the costs of capital (e.g., depreciation, interest) as well as operating, or variable, costs. If the amount of capital is allowed to vary, average costs are considered "long-run" and one of the prices (P_i) in equation (3-1) must reflect the cost of capital. If the amount of capital is held constant, average costs are "short-run" and a measure of actual capital stock must be included in the cost equation.

The basic PPS payment rate is neither of these average costs. Rather, it is short-run average operating cost per admission. Capital costs are reimbursed as a separate pass-through under PPS, and so are subtracted from total costs to determine the standard average operating cost used as the hospitals' base payment rates.*

The Q and P of equation (3-1) are proxied in PPS by two measures of hospital output (the case mix index and residents per bed), and one price measure, a wage index. The basic regression for this study, given these adjustments, is:

$$AOC = f(CMI, OUTLYER, RESPERBD, WI, TYPE, BEDS) + e \qquad (3\text{-}2)$$

where

AOC = average operating cost,
CMI = case mix index for the hospital,
OUTLYER = proportion of costs attributed to outlier cases,
RESPERBD = residents per bed,
WI = HCFA wage index for the relevant labor market,
TYPE = Type of hospital: RRC, other rural or urban.
BEDS = Number of licensed beds in the hospital

The case mix index is a composite measure of the many different types of cases that make up the basic product of a hospital. The index is a weighted average of the cases in each DRG category. Because the DRG weights are derived from averages of standardized costs, the index should have a linear

*In the Medicare Cost Reports, a small residual of capital costs is stepped down into operating expenditures and hence into the PPS base rates. On September 1, 1987, HCFA published amendments to the PPS regulations to include payment for capital costs. (Federal Register, Vol. 52, No. 104, page 33168).

relationship with costs. An index of 1.1 should be associated with 10 percent higher costs than an index of 1.0, all other things remaining constant. Table 2-8 in Chapter 2.0 shows that the average RRC has a case mix index of 1.11 vs. 1.00 for the other rural hospitals, an 11 percent difference. A proportionate increase in the average Medicare payment to RRCs already occurs under PPS, precisely because its cases are 11 percent more costly on average.

A second explanation of higher RRC costs is teaching status. Indirect medical education costs are reimbursed on the basis of residents per bed. More residents for a hospital of a given number of beds should increase costs per admission because this joint product supposedly requires more resources for paperwork and ancillaries (e.g., x-rays). Because the average RRC has 20 times the number of residents per bed of the average rural hospital, teaching costs should accentuate the cost differences between these groups.

A third explanation of higher costs is higher wages in the State where an RRC is located. A Federal wage index corrects for these price differences. The Federal prospective payment rates are divided into labor and nonlabor components. If a hospital is located in an area with a wage index 10 percent above the standard, the labor component of the Federal rate is multiplied by 1.1, increasing the amount that hospital receives for each DRG category. Similarly, if a hospital is in a low wage area, the labor component of the federal Medicare rate will be reduced.

From Table 2-9, (Chapter 2.0) we learned that the average RRC has roughly the same wage index as other rural hospitals (.88 vs. .86) but the urban average is higher (1.09). This urban/rural difference may obscure similarities in costs that might exist between RRCs and urban hospitals. Because of this and because wage differences are already included in the PPS rates, this third explanatory factor must also be included in the regression equation. Ideally, other input price indexes would also be included. None is currently available, however.

Finally, a measure of the quantity of output should be included in equation (2). Two possible measures are the aggregate number of cases and the number of hospital beds. Using either as a scale measure confuses the scale of production with the greater diversity of cases treated in larger hospitals. Either measure may pick up the influence of excluded variables such as outliers, quality of care, or severity. Indeed, models which included the number of admissions as an explanatory variable gave results very similar to those including hospital bed size. For some models presented below, bed

size is included as the proxy for these and other unknown variables and to be consistent with other work. By stepping the bed size variable into the regression only after the PPS cost factors are included, we can estimate how much of RRCs' higher costs per case are accounted for by the factors for which PPS adjusts and then measure how much of the unexplained variance is attributable to bed size, for which no adjustment is made.

3.2.2 Sources of Error

Beginning with this general overview, we now consider three possible sources of error in regression analysis of particular concern in this study:

1) excluding relevant explanatory variables,

2) variable measurement error, and

3) incorrectly constraining (or not constraining) the regression coefficients.

3.2.2.1 Excluded Variables

In an ideal regression analysis, all relevant explanatory variables are included, either by a direct measure or by a proxy. If a relevant explanatory variable is omitted, its influence on the dependent variable (cost per admission) might be proxied by an included variable that is highly correlated with the excluded variable. This would bias the coefficient of the correlated variable and possibly bias our RRC finding (Pindyck and Rubinfeld, 1981, pp. 128-130). For example, if a measure for capital costs is excluded from the regression, the variable for RRCs may pick up the influence of capital (because designation as an RRC is presumably highly correlated with larger capital costs) but so might the case mix index or the measure of indirect teaching costs.

In addition to capital costs, other important variables that are excluded from the regression analysis (for lack of data) are measures for the quality of care, severity of illness within each DRG category, and hospital inefficiencies. Quality and severity are factors that HCFA is currently seeking to measure. Whether or not an adjustment to payment rates for severity or quality differences is called for, holding them constant is

essential in order to obtain accurate coefficients for the other variables. An accurate adjustment for severity might resolve many existing problems, including the one hypothesized for RRCs. Presumably the other two (quality and hospital inefficiencies) will be positively correlated with the case mix index and teaching status as well as with a hospital's designation as an RRC. Therefore these coefficients may be biased and the statistical tests for higher RRC costs may indicate lower costs when they should not.

Another problem of an excluded variable arises with respect to the wage index. No measure of differences in other input prices is available for inclusion in a regression. If the prices of food, energy, and hospital supplies are highly correlated with the wage index, excluding a price index for other inputs will increase the effect of the wage index in explaining costs and reduce the statistical difference in costs between hospital types. This would be inaccurate because PPS currently makes no adjustments for other price differences.

3.2.2.2 Measurement Error

This study was done using 1984 data for hospital costs and casemixes. Between 1981 (the base year for PPS) and 1984, dramatic changes occurred in the hospital industry. The average LOS fell by two days. Staffing and purchasing arrangements were also altered in an attempt to control costs. Further, hospitals were relatively unused to the record-keeping required by DRGs in 1981. Since then, the coding of case mix has improved, with the result that the average casemix index is much higher today. Therefore some of the measurement error that existed in studies using 1981 data has been reduced.

However, the use of 1984 data still raises a source of measurement error. The 1984 casemix index is calculated for the hospital's fiscal year 1984, not the Federal fiscal year. Therefore, the 1984 CMI is not quite in phase with the costs per case and other 1984 variables. An estimated case mix index was calculated for the Federal fiscal year using an average of the 1984 and 1985 indexes weighted by the proportion of the year each hospital was on PPS.

3.2.3 Estimation Method

3.2.3.1 Unconstrained Regression

Many standard regression models do not constrain the coefficients of the explanatory variables in any way. For example, Pettengill and Vertrees (1982) estimated an unconstrained model in examining the reliability and validity of case mix measures.

Theory suggests, however, that there are upper and lower bounds on the effects (and therefore the coefficients) of the cost factors. (For example, the coefficients of the case mix and wage measures should not be negative, which would imply that costs went down as cases became more severe or wages decreased.) PPS reimbursement rules also constrain the wage and case mix effects. The FY 87 wage adjustment is made to only 75 percent of hospital costs, implying that costs should rise only 75 percent for every 100 percent increase in relative wages.

In Section 3.3.1, the results of an unconstrained ordinary least squares regression model are presented and discussed. The explanatory variables are stepped in one at a time so that the marginal impact of each on the model's explanatory power can be seen. RRCs are the group represented by the constant and separate dummy variables for other rural and urban hospitals show the significance of cost differences between each of these two groups and the RRCs as each additional PPS factor is held constant.

3.2.3.2 Constraining the Model

Although the functional form of the cost model implicitly imposes constraints on the coefficients of a regression, sometimes the coefficients of models are further constrained so that their values do not exceed some bound (e.g., negative costs or output are ruled out). If constraints are not imposed, the estimated effects may be unrealistic. Such a problem is recognized for models of hospital costs in which the unconstrained coefficient of the case mix index is much higher than 1.0. One way to further "constrain" this coefficient is to include hospital bed size and SMSA size as explanatory

variables in the regression. These variables are highly correlated with the case mix index. Including them decreases the coefficient on the index. However, this is not the only, or best, method for constraining the coefficients to the values assumed by PPS.

Another way to constrain the regression coefficients is to standardize each hospital's cost per case using the PPS factors according to the assumptions implicit in PPS. For example, by dividing the average cost per case by the case mix index, the influence of the index on costs is constrained to be 1.0. Similar constraints can be imposed on the wage index, the cost-of-living adjustment, and the indirect medical education adjustment.

From the standpoint of whether RRCs' costs are different from those of other rural or urban hospitals, we concentrate on the result of these constrained regressions. However, in consideration of both previous unconstrained work and the desire to examine RRCs under the rules of PPS, we present both. This has the added advantage of showing the sensitivity of the estimations to the form of the regression model.

3.2.3.3 Development of Transfer Variables

In analyses to explore the cost factors underlying the correlation of bed size and average cost per admission, HCFA staff have developed two measures of referral or transfer activity.* These measures were generated from the 1984 PATBILL file and captured over 200,000 instances of Medicare beneficiaries being discharged from one hospital and admitted to another hospital on the same day (out of 10.8 million inpatient stay records). These cases were assumed to be transfers. They were aggregated for the hospitals of discharge as "cases sent as transfers" and for the hospital of admission as "cases received as transfers." These numbers were then transformed into proportions of the hospital's total cases that were received and sent.

These variables are the first attempts to measure degrees of actual referral activity on a large scale. Two major sources of measurement error are:

*Bobula, J. "The Impact of Hospital to Hospital Transfers on Hospital Costs," Working paper, HCFA, Office of Research, March 1986.

1. the systematic understatement of transfers because a number of referral mechanisms could not be documented;

2. random variation in referral patterns so that the 1984 measure does not consistently identify only those hospitals that are referral centers.

The first point is that this measure cannot capture hospital-to-hospital transfers for which there was a delay of a day or more between discharge from one hospital and readmission to another or those referrals made directly by physicians, emergency rooms, or other agencies (for which there are not two hospital admissions). Therefore, the referral measures understate true referral activities. The second source of error is the random fluctuation of cases requiring transfer from one year to the next. While the variations may be a small number of cases, they will produce larger variations in the measures for small hospitals (with smaller numbers of cases) than for large hospitals.

Keeping these sources of measurement errors in mind, we will use the transfer varibles as the best proxies available of hospital-to-hospital referrals to analyze whether this captures the bed size effect on average hospital costs.

3.3 Empirical Results of RRC Cost Models

The questions we will be addressing in the regression analysis are:

1) Is there a significant difference in cost between RRCs and other rural hospitals once case mix, teaching, outliers and the wage index are held constant?

2) Is there a significant difference in cost between RRCs and urban hospitals once the other three variables are held constant, all other things remaining equal?

3) Is there a significant difference in hospital costs across Census divisions?

4) Does hospital-to-hospital transfer activity explain RRCs' cost differences, if any exist?

3.3.1 Unconstrained Regression Models

Table 3-1 summarizes the results of seven logarithmic regressions of hospitals average costs per case. The first model shows that other rural hospitals were 30 percent less expensive for Medicare cases than RRCs in 1984.* This was about $710 less than the average RRC cost per case of $2,368 (the antilog of 7.77). Urban hospitals were 28 percent ($673) more expensive than RRCs. Both coefficients are highly significant but include cost differences that could be due to case mix, wage or teaching differences for which the hospitals are already compensated.

When case mix is introduced as an explanatory variable in model (2), the RRC/other rural differential drops to 11 percent. More than half of the difference between RRCs' costs and those of their rural neighbors is due to their more severe mix of cases. The RRC/urban cost difference, on the other hand, has increased to 30 percent. The coefficient for the case mix index is unconstrained, however, and the coefficient of 1.53 represents a 153 percent increase in cost per case if the case mix index increases 100 percent. This is far too much influence for the case mix to wield. However, it may be picking up the influence of wages, teaching, or other factors that are highly correlated with having a more severe case mix.

The introduction of the ratio of interns and residents to beds (model (3)) does reduce the coefficients for both the urban hospitals (30 to 26 percent) and the case mix index (to 1.37 or 137 percent). The RRC/other rural cost difference is unaffected. Higher teaching involvement, then, is largely correlated with higher case mix indexes. The coefficient for the variable "ratio of interns and residents to beds" represents the change in the dependent variable for a given percentage change in one plus the ratio of interns and residents to beds. Therefore, the unconstrained coefficient of the teaching measure 0.99 translates into a percent increase in costs per case equal to 99 percent of the percent increase in one plus the ratio of residents

*Researchers generally interpret dummy variable coefficients in semilogarithmic equations as arithmetic percentage differences. Halvoren and Palmquist (1980), however, demonstrate a bias using the unadjusted coefficients, which increases with the size of the difference. In fact, each coefficient (a) is an estmate of $a = \ln(1+g)$ where 100g is the correct percentage difference. Exponentiating and solving for g gives $g = [\exp(a) - 1]$. For $a = .05$, $g = .0513$, a trivial difference, whereas for $a = .50$, $g = .649$. All dummy coefficients discussed in the text are therefore transformed into simple arithmetic differences using $g = [\exp(a) - 1]$.

TABLE 3-1

EXPLAINING VARIATION IN INPATIENT COST PER MEDICARE ADMISSION, 1984

	Dependent Variable: Natural Log of Total Inpatient Cost per Medicare Admission						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant[a]	7.77***	7.62***	7.62***	7.79***	7.48***	7.51***	7.82***
Other Rural Hospitals[b]	-0.30***	-0.11***	-0.11***	-0.09***	-0.03	-0.02	-0.04**
Urban Hospitals[b]	0.28***	0.30***	0.26***	[c]	0.01	0.03	0.01
Casemix Index		1.53***	1.37***	1.28***	1.06***	0.98***	1.11***
Interns and Residents per bed			0.99***	0.83***	0.69***	0.69***	0.75***
Wage Index				1.12***	1.13***	1.00***	1.13***
Number of Beds					0.06***	0.07***	
Proportion of Cases Received as Transfers							0.96***
Porportion of Cases Sent as Transfers							-2.00***
Regions[d]:							
Middle Atlantic						-0.12***	
South Atlantic						-0.08***	
East North Central						-0.09**	
East South Central						-0.12***	
West North Central						-0.17***	
West South Central						-0.13***	
Mountain						-0.07***	
Pacific						-0.06***	
R^2	.40	.53	.56	.64	.65	.68	.65
f-ratio[e]	1686.97	1903.78	1586.28	1756.59	1529.25	675.85	1306.42

N = 5020

[a]Rural Referral Centers are in the constant. Cost per admission, casemix index, residents per bed, wage index, number of beds and transfers received and sent were transformed to natural logarithms. One was added to "Residents per bed," "Cases Received" and "Cases Sent" before transforming it to a log.

[b]Coefficients have been transformed according to the method footnoted on page 3-11.

[c]Less than 0.005

[d]New England region is in the constant.

[e]All f-ratios are significant at the one percent level.

***Significant at one percent level
**Significant at five percent level
*Significant at ten percent level

Sources: Medicare Impact FY87 File, American Hospital Association 1985 Annual Survey of Hospitals.

to beds. For example, if the ratio of residents to beds increases from 0.02 to 0.03, the number that we are taking the natural log of increases from 1.02 to 1.03—about a 1 percent increase--and costs per case will increase by 0.0099 percent (=(0.99)(.01)).

When wages are held constant (model (4)), the RRC/other rural cost differential is reduced slightly, to a still highly significant 9 percent. The three primary cost factors in PPS do account for the majority of the difference in average cost between RRCs and their rural neighbors with most of the difference seemingly accounted for by the case mix. The RRC/urban differential, on the other hand, disappears as a statistically significant value when wages are held constant. The major factor in the higher urban costs appears to be higher wages.

These conclusions are based on unconstrained regression coefficients which show costs rising 128 percent with a 100 percent increase in the case mix, 83 percent of each percent increase in the teaching ratio, and 112 percent for each 100 percent increase in the wage index. These three cost factors are accounting for much more variation in costs than is theoretically possible. This undoubtedly biases the coefficients for other rural and urban hospitals. Therefore, the coefficients for case mix, teaching and wages must be constrained to the PPS values.

One method of constraining is to introduce bed size as an explanatory variable (model (5)). This variable reduces the RRC/other rural cost difference to a statistically insignificant three percent. The RRC/urban cost difference remains insignificant at 1 percent. It appears that the rural differential is due to bed size and the RRC adjustment corrects for higher costs that accompany larger size or quantity. But does bed size properly constrain the coefficients of the other factors?

In model (5), the case mix index still has an effect 6 percent greater than it should have in theory. Similarly, the wage index has a coefficient that is too high because it indicates that an increase of 100 percent in wages will increase costs by more than that amount. This is not theoretically correct.

Another explanation of the results in Table 3-1 is suggested by Table 2-11 in Chapter 2.0. The concentration of RRCs in low cost regions and other rural hospitals in expensive regions (aside from the wage adjustment) could account for the results. When regional dummy variables were added, the results in column (6) of Table 3-1 were obtained. Region clearly affected all the other explanatory variables, but it did not cause the RRC/other rural or RRC/urban distinctions to change. Even accounting for region, when bed size is not

included, RRCs are significantly higher in cost per case than are other rural hospitals in a logarithmic regression model. When bedsize is included, RRCs and other rural hospitals have the same costs per case.

Across regions there are large, significant differences in cost. Compared to New England, all the other regions are less expensive, all other things being equal. The East North Central, Pacific, Mountain, and South Atlantic States are next most expensive (6-9 percent less, once wage differences are accounted for) followed by the Mid-Atlantic states, the West Central and the East South Central regions. The West North Central region is the least costly per case (by about 19 percent), all other things being equal.

Column (7) in Table 3-1 shows the result of substituting transfers for bed size. Both measures have highly significant coefficients with the signs expected. Receiving transfer cases increases costs per case by 96 percent of each percent increase in transfer cases. For example, if transfers rise from 1 percent of all cases to 2 percent, costs percase rise by 0.0096. Sending transfers lowers costs 200 percent for each percent increase in the proportion of cases sent. That is, if the proportion rises from 0.03 to 0.06, costs per case will drop by 6 percent (200 x .03).

In this cost model, these two new variables have no additional effect on the RRC-urban hospital difference. It remains statistically insignificant once wages are held constant. However, the two transfer variables do not replace bed size as an explanatory factor between RRCs and other rural hospitals in that the differential in model (7) is significant at the 0.05 level while that in (5) was statistically insignificant. Other forms of the transfer proportions such as a net-receiver variable yielded similar results. The coefficient estimate is highly significant but adds nothing to the RRC cost differentials or the unexplained variance in hospital costs. RRCs are still significantly more costly per case than other rural hospitals ceteris paribus, but the difference is only half that when only the PPS factors are held constant.

The major problem with model (7) remains the biases in the coefficients that are a result of the case mix and wage measures being unconstrained. For example, the fact that the wage coefficient is more than what is theoretically acceptable biases the urban hospital coefficient down, disguising RRC/urban differentials. The effect of the case mix index in model (7) is greater than what the PPS adjustment allows and this may also bias the coefficient for the other rural hospital group below its true value.

Summary

The unconstrained regression estimates support the hypothesis that RRCs are more costly per case than other rural hospitals and as costly as urban hospitals. Further, the introduction of bed size as an explanatory variable shows that the RRC adjustment is for one or more factors related to bed size. The hospital-to-hospital transfer measures capture some, but not all of the factors proxied by bed size.

Nevertheless, these results cannot be accepted at face value because the coefficients of variables included in the PPS payment formula are not constrained. They consistently have much greater values than can be supported by the theory of costs. For example, the wage coefficient implies that when relative wages are doubled, costs per case are more than doubled. If little substitution of labor for nonlabor inputs is possible, the implications of the unconstrained regression is illogical.

3.3.2 Constrained Regression Models

The regression results presented in Section 3.3.1 show how RRCs' costs compare to those of other rural hospitals if PPS were to adjust payment rates as indicated by the coefficients of these regressions. However, the coefficients of all the regression models are consistently higher than the amounts paid under PPS with the exception of the "double teaching" adjustment. If the number of hospital beds is excluded, the coefficients for casemix and wages are higher than what PPS allows and the coefficient for interns and residents is higher than the value that is then doubled in the PPS adjustment. When the number of hospital beds is included (even though the coefficient on the case mix index is reduced), the effects of residents per bed and relative wages are still significantly higher than the parameters implicit in the cost model underlying PPS, i.e, .579 and .80 respectively.

Our initial questions in this section are:

1) If we constrain the coefficients of the hospital's case mix, wage index, and teaching status to reflect the parameters implicitly underlying the way PPS pays for these differences, is there a significant difference in cost between RRCs and other rural hospitals?

2) If we constrain the coefficients, is there a significant RRC-urban difference?

The most straightforward way to constrain the regression is to standardize the dependent variable, cost per Medicare admission, by the values used in PPS. This is shown in equation (3-3):

$$SAC = \frac{\frac{(\text{actual cost})(\%\ \text{labor})}{\text{wage index}} + \frac{(\text{actual cost})(\%\ \text{nonlabor})}{\text{cost of living adjustment}}}{[\text{case mix index}][1+.579(\text{residents per bed})]} \qquad (3\text{-}3)$$

where SAC is standardized average cost, % labor and % nonlabor are .79 and .21 respectively, the wage index is determined for the hospital's location, and the actual cost and residents per bed are the hospital's values for the 1984 Federal fiscal year. Indirect teaching cost increases are deliberately not constrained to the double teaching adjustment but rather to the value found in HCFA quantitative work to be the actual effect of medical residents on costs per case. However, an average of each hospital's 1984 and 1985 casemix indexes was calculated so that it would reflect the case mix severity for the same period of time as that of costs, the wage index, and data for residents per bed. When this is done, and the standardized costs are regressed on the type of hospital, with and without bed size, the results are those shown in Table 3-2.

Model (1) in Table 3-2 is analogous to model (4) in Table 3-1. Both hold constant the influences of case mix, teaching, and wages on costs per case. However, when these influences are constrained to the PPS parameters, the RRCs are 13 percent more costly on average than are other rural hospitals and 9 percent less expensive than urban ones. This compares to 9 and 0 percent respectively for the model in which explanatory factors have no upper bound.

In the second model in Table 3-2, bed size is introduced as an explanatory variable. This model is analogous to (5) in Table 3-1. The results have one major difference. Bed size is a highly significant factor and captures the difference in costs between RRCs and other rural hospitals in both the unconstrained and constrained models. However, when case mix, teaching involvement and, especially, the wage index are constrained to the parameters of PPS, urban hospitals are 11 percent more costly per case in 1984 than RRCs. This difference is statistically significant at the 1 percent level of confidence.

TABLE 3-2

EXPLAINING VARIATION IN STANDARDIZED INPATIENT COST PER MEDICARE DISCHARGE, 1984

	(1)	(2)	(3)	(4)	(5)	(6)
Constant[a]	7.75***	7.38***	7.50***	7.77***	7.66***	7.65***
Other Rural Hospitals[b]	-0.13***	-0.02	-0.02	-0.05**	-0.08***	-0.04**
Urban Hospitals[b]	0.09***	0.11***	0.08***	0.09***	0.03**	0.03*
Number of Beds[c]		0.07***	0.07***			0.01
Regions[d]:						
Middle Atlantic			-0.11***			
South Atlantic			-0.13***			
East North Central			-0.09***			
East South Central			-0.13***			
West North Central			-0.20***			
West South Central			-0.16***			
Mountain			-0.09***			
Pacific			-0.04**			
Proportion of Outlier Payments					3.10***	3.34***
Proportion of Cases Received as Transfers				0.95***		-0.31*
Proportion of Cases Sent as Transfers				-2.17***		-1.16***
R^2	.14	.29	.29	.18	.29	.30
f-ratio[e]	442.84	376.67	126.14	275.40	747.86	392.42

N = 5543

[a]Rural Referral Centers are in intercept. The dependent variables are the natural logs of total inpatient cost per Medicare admission standardized for the hospitals' wage indexes, 1984 casemix index, and indirect medical education costs or using an 84-85 CMI..

[b]Coefficients have been transformed according to the method footnoted on page 3-11.

[c]This variable and the dependent variable were transformed to natural logarithms.

[d]New England region is in the constant.

[e]All f-ratios are significant at the one percent level.

***Significant at one percent level
**Significant at five percent level
*Significant at ten percent level

Sources: Medicare Impact FY87 Files.

The third model in Table 3-2 introduces dummies for eight of the Census divisions (analogous to column (6), Table 3-1). All of the divisions are significantly less costly than New England, with the size of the coefficients similar to those in the unconstrained model. RRCs remain significantly less costly than urban hospitals.

Models (4), (5), and (6) explore whether two other variables explain the bed size effect. In column (4), the two referral measures developed by HCFA (proportions of cases received or sent as transfers) are held constant, along with the hospital type. Both variables are highly significant cost factors, explaining more than half of the 13 percent difference in costs between RRCs and other rural hospitals in model (1). The remaining 5 percent difference is still statistically significant at the 5 percent level of confidence, however. Further, the coefficients on the transfer variables indicate a very large effect on costs. Costs rise .0095 for every 1 percent increase in the proportion of cases received as transfers. They drop over 2 percent for every percent increase in the proportion that is sent. This is nearly identical with the coefficient estimates in the unconstrained regression model.

The proportion of payments that are due to outliers is introduced in model (5) as another substitute for bed size. The effect of this variable is to reduce the RRC/other rural cost difference by about one-third (but the 8 percent difference is significant at the one percent confidence level) and to cut the RRC/urban difference by two-thirds to a statistically insignificant 3 percent. The coefficient is very large. From the coefficient of 3.10 we can infer that average cost per case increases by about 3 times the percent increase in the proportion of outlier payments. For example, if outliers increase from 1 percent to 2 percent of Medicare cases, average cost per case will be higher by 3.1 percent.

Neither the outlier nor the transfer proportions eliminate the effect of bed size when the latter is introduced into models (4) and (5). However, when all three are held constant along with bed size (column (6) in Table 3-2), bedsize is reduced to a statistically insignificant cost factor. The presence of the outlier measure also reduces the elasticities of the transfer variables, especially that of transfers received which has its sign reversed. This suggests that the proportion of cases received as transfers correlates highly with the proportion of outliers. The combined use of the outliers, transfers, and bed size as explanatory variables leaves small but significant

differences in the 1984 average standardized costs per case between RRCs and the two comparison groups. Their costs are approximately halfway between those of other rural and urban hospitals.

Summary

The constrained regressions confirm that RRCs are 10-12 percent more costly per case than other rural hospitals holding constant the basic PPS parameters of case mix, teaching, and wages. Further, this remaining difference is largely a matter of bed size, which may be proxying differences in referral activity. Since the referral activity is not proxying case mix differences, the likely candidates are: 1) systematic differences in severity within diagnostic groups, 2) differences in outlier cases, or 3) differences in fixed equipment or staffing costs related to receiving rather than sending referral cases.

On the other hand, RRCs are not as costly per case as urban hospitals when the coefficients for case mix and wages are constrained to the PPS values. This difference, of 9-10 percent, is not explained by bed size or referral activity. It is reduced significantly when outliers are controlled for but the large coefficient for the latter factor suggests that the cost differences are proxied, more than explained, by outliers.

3.3.3 Simulations of PPS National Payments vs. Costs

The unconstrained multivariate regressions indicate that RRCs are indeed more costly than other rural hospitals by 7-10 percent when the 1984 PPS payment factors were taken into account and significantly less expensive than urban hospitals until the relative wage index was taken into account. Holding this relative price measure constant reduces the RRC/urban difference to a statistically insignificant amount. However, to accept this result at face value requires us to accept the regression estimates as measures of how PPS pays for various hospital cost factors.

When the coefficients are held constant at their PPS values, by standardizing the costs per case for case mix, relative wage index, and numbers of medical residents, RRCs are significantly more expensive than other rural hospitals but significantly less expensive than urban hospitals. The

introduction of the proportion of outlier cases and bed size as explanatory variables dampens the magnitudes of these differences, but RRC costs remain significantly between the rural and urban groups

A third check on these relationships is provided by a simulation of how hospitals would have fared under fully national PPS rates in 1984. This simulation was done using equation (3-4):

$$\text{Payment} = [[(\text{LRP}*\text{WI}) + (\text{NLRP}*\text{COLA})]*\text{CMI}][1 + \%\ \text{Outliers}][1+\text{IME}] \qquad (3\text{-}4)$$

where:

LRP = the 1985 labor-related payment amounts for urban and rural hospitals deflated by 1.058

WI = the PPS wage index in 1984

NLRP = the 1985 non-labor related payment amounts for urban and rural hospitals deflated by 1.058

COLA = the PPS adjustment for other prices in Alaska and Hawaii in 1984

CMI = the hospital's own PPS case mix index for 1984

Outliers = the proportion of the hospital's 1984 payments calculated by HCFA to be due to outliers

IME = the indirect medical education adjustment for 1984 based on the ratio of residents to beds.

These payment rates were then compared to a measure of the hospital's own costs per Medicare case: 1984 cost per case based on the Medicare Cost Reports. The mean difference between payments and costs is shown in Table 3-3. The means in Table 3-3 suggest what the average difference between PPS payments and costs might have been in 1984 if the system were already paying according to national urban or rural rates with RRCs receiving the urban rate.*

*The averages of the actual payments would have been different because 75 percent of the 1984 payment was the hospital specific portion, and the other 25 percent of the payment was based on the regional, not the national, amounts. However, simulating the actual payments could not have addressed the question at hand, which is whether RRCs should be paid the national urban rate.

TABLE 3-3

MEAN DIFFERENCES BETWEEN SIMULATED NATIONAL PAYMENTS AND COST ESTIMATES FOR RRCs VERSUS OTHER HOSPITALS, 1984

	RRCs	Other Rural Hospitals	Urban Hospitals
Unweighted Means:			
100% National Payment Rate less Estimated Cost per Case with RRCs given urban rate	$528.63	$90.91	$468.43
(Standard Deviation)	(406.85)	(568.31)	(712.67)
100% National Payment Rate less Estimated Cost per Case with RRCs given rural rate	$-81.90	$ 90.91	$468.43
(Standard Deviation)	(395.37)	(568.31)	(712.67)

Note: The high average "overpayment" for urban hospitals could be due to the double teaching adjustment in Fiscal 1984, the increase in the hospitals' casemix indexes compared to the 1981 base period, and to the fact that the mean is unweighted by the number of cases so that small, low-cost hospitals that are likely to receive a "profit" on their Medicare cases are more heavily represented in the mean value than would be true with case-weighting. For 1988, under OBRA provisions, case-weighting will be used.

From Table 3-3, we conclude that RRCs would have been significantly overpaid in 1984 by the national urban rate had PPS been past transition at that time. Their average excess of payment over cost was over five times as great as that for other rural hospitals and more than 10 percent higher than for urban hospitals. Further, the standard deviations for the mean values indicate that the dispersion of values for the RRCs was much narrower than for either of the other two categories. In the simulations, less than 10 percent of the RRCs would have received consistent losses per case had they been on the national urban rate compared to over 25 percent of other rural hospitals and over 10 percent of urban hospitals.

Similar simulations using the national rural payment rate for RRCs showed a mean loss of $82 for the RRC category. (See Table 3-3.) While this suggests that RRCs' costs are, on average, higher than those of other rural hospitals, they are far from the level of urban areas.

3.4 Summary

The general conclusion of this chapter is that, indeed, RRCs' costs are significantly higher than those of other rural hospitals and significantly below those of urban hospitals. This is shown most clearly by the constrained regressions (Table 3-2) that use the 1984 Medicare costs per case standardized for cost factors according to the PPS payment formula. These regressions show that RRCs about 13 percent more expensive on average than other rural hospitals holding constant PPS factors of case mix, teaching, and wages. However, they are also significantly less expensive by 9 or 10 percent ($200) than urban hospitals, when PPS adjustments for case mix, teaching, and wages are held constant.

In addition to the analyses described thus far, additional regression analyses were performed that excluded the four previously waivered States of New Jersey, New York, Massachusetts and Maryland. Excluding these States, which contain some of the most costly urban hospitals in the country, does not change the statistical significance of any coefficients with the exception of the regional dummy variables. The overall conclusions and policy recommendations of this report remain unchanged.

The RRC/other rural difference is captured primarily by the number of hospital beds. Measures of referral activity developed by HCFA also reduce the RRC/other rural cost differential but leave a significant gap of 5 percent. The likely factors it proxies are: 1) systematic differences in severity within diagnostic groups, 2) differences in outlier cases, or 3) differences in standby costs related to receiving, rather than sending, referral cases.

The RRC/urban differential is closely related to the proportion of outliers in the hospitals. Introduction of this factor reduces the RRC/urban difference by two-thirds. The large elasticity of 3.5 suggests that costs rise much more rapidly than the payment for outliers recognizes. This may be due to outlier costs themselves pulling up the average or it may represent the greater costs of hospitals that are more aggressive in treatment style and therefore more likely to receive the difficult outlier cases.

These results indicate that the RRCs might not be adequately paid if they were simply given the rural rate even if it were adjusted for transfer or outliers in accord with the coefficients in Table 3-2. This would depend on the actual transfer or outlier adjustments, of course. With a simulated average loss per case of only $82 for RRCs, under a scenario of being paid based on fully Federal rural rates, a relatively small adjustment might allow the average RRC to break even. Section 9302 of the Omnibus Budget Reconciliation Act of 1986 changed the PPS payment calculation methodology, which should narrow the difference between rural and urban hospital Medicare operating margins. In future research, further refinements of these measures to remove biases might also yield more significant reductions in the cost differentials between the three hospital groups.

4.0 SERVICE AND LABOR MARKET AREAS OF RRCs

This chapter examines the evidence that bears on two important claims made for RRCs:

1) They serve a wider area or broader, more diverse population than other rural hospitals; and

2) They must compete in regional or national labor markets for skilled medical workers and so have higher average wages than other rural hospitals.

4.1 RRC Service Areas

Chapter 1 traced the changes that have occurred in the definition of an RRC with respect to its geographic service area. At first, the emphasis was on having a widely dispersed patient population. This emphasis on geographic service area has been subordinated to other measures of treating the sickest patients: namely, actual proportions of patients referred and the proportion of specialists on the staff. Even so, service area is potentially an important characteristic differentiating RRCs from other rural hospitals. In addition, the question of whether the shift in definition was warranted needs to be addressed.

4.1.1 Lessons from the Literature

Unfortunately, the type of data that is needed to determine hospital service areas ("patient origin data") is not generally available. Patient origin studies began only in the late 1940s. Prior to that, policymakers and researchers assumed that hospital service areas would conform to retail trading areas because "people prefer to go to the nearest hospital suitable for the type of sickness involved." (Griffith, 1978, p. 16) Griffith reports that most of the patient origin studies have been conducted by planning groups in the Midwest. As such, they do not deal with RRC as a group. However, Griffith summarizes the findings of a number of studies:

> ...some patients travel farther than 30 miles for hospital care. Fifteen to 25 percent of patients leave rural communities with limited service hospitals. Less than 15 percent leave areas with medium sized, well equipped hospitals and a complement of medical specialists. (Griffith, footnote on p.16)

In a similar vein, he notes (p. 19) that for a rural community with a single hospital, virtually no one outside a 15 mile radius is likely to use the hospital. When there is more than one hospital, the service areas will overlap and specialization often occurs, although it does not have to be along the lines of case severity. It is not clear from existing studies whether this extends the geographic service area, but the cities mentioned are large enough to be considered urban, so these findings are suggestive at best.

4.1.2 Six Case Studies of Patient Markets

Even though only a tiny percent of the population 15 miles from a rural hospital uses its services, these can constitute a substantial number of patients. To address this possibility, six case studies were conducted either in person or by telephone interview. The hospitals were not chosen to be a representative sample but to illustrate the diversity of RRCs. They were in three different regions and ranged widely in size, case mix index, and their distance from an urban area.

In the evidence they presented on patient origins, they were as varied as in other characteristics. A pattern is suggested, however. If the RRC is large (say, in the top 20 percent of RRCs) and in a very small town (population well below 20,000), the majority of its patients will come from more than 25 miles away. In fact, in hospitals we visited, the proportion of "long distance" patients was well over 60 percent. This may mean simply that a large hospital cannot survive in a sparsely populated area with no "large" small town unless it serves an area much larger than the average.

For hospitals located in somewhat larger towns, the referral patterns depended more on the distance to the next suitable hospital. A larger town provides a large number of patients locally. Patients living more than 25 miles away could be competed away by a hospital just 50 or 60 miles away. The presence of such a close competitor could greatly reduce both the number and the proportion of long distance patients even though the study hospital was a referral center by other criteria.

Case study RRC hospitals located between two nearby urban areas (as could easily happen in almost every State except the West North Central, West South Central, and Mountain States, plus Alaska and Hawaii) did not have as

widely dispersed a service area. Patients 25 miles or more from the RRC were generally close to an urban area and may have chosen their doctors and hospitals as they chose their retail goods, in the city.

Finally, the case studies suggest that the size of a hospital's service area is confounded by the presence of a major teaching hospital (e.g., one affiliated with a medical school) within about an hour's drive. This appeared to be a factor whether the teaching hospital was urban or rural. An hour's drive may be about the limit of what a patient or a patient's family is willing to travel for medical care or to visit. In any event, when a teaching hospital was relatively nearby, the service area of the designated RRC was much smaller.

4.1.3 Conclusions on RRC Service Areas

The case studies confirm the belief that there is no simple distance criterion that could differentiate all referral centers from nonreferral rural hospitals. It also confirms the conclusion that the original 100 mile travel distance for designating RRCs was too stringent. If two RRCs are an hour or less apart, there may be some specialization between them. In general, however, RRCs refer some cases to major urban hospitals, even if that means transporting them a great distance. These cases are almost always burn cases, neonatal intensive care cases or organ transplants. RRCs do not usually receive referrals from urban areas, although it is not unknown. Only a very few RRCs appear to be referral centers at the regional or national level.

4.2 RRC Labor Markets and Average Wages

One argument advanced to explain why RRCs' costs should be higher than other rural hospitals' costs is the expense of special medical workers. Rural wages are generally lower than urban rates, reflecting the lower rural cost of living. However, RRCs claim to have a mix of more highly trained workers who are in short supply on the regional or national labor market. To attract these workers, some RRCs claim to offer a wage that is higher than other rural hospitals, approaching, if not equal to, urban

wages. If this is true, then the (downward) adjustment to labor costs using the Federal rural wage index is too great and reduces payments for RRC labor costs more than would be justified by their actual wage payments.

Another line of reasoning advanced by some RRC administrators is that RRCs have a higher proportion of specialized professionals in their workforce and that this (not higher wages per se) raises the average salary per worker. For example, all rural hospitals in an area may hire medical technologists for a wage of $10 per hour. The RRC in that area, however, may have to have 1.5 technologists for every two assistants instead of only one. This would mean that the RRC would have a higher average wage per worker even though the wage paid for each category of worker is exactly the same. Some categories suggested as examples of this line of reasoning are radiation specialists and technicians for hemodialysis and renal dialysis.

Recent work for the Prospective Payment Assessment Commission (Hendricks, et al., August 1986) suggests that the wage index is not the appropriate mechanism to adjust for different mixes of occupations or types of staff. If the occupational mix is due to the mix of cases, the HCFA wage index is distorted because it aggregates over all occupation groups instead of holding the labor market basket constant. The distortion is small but consistently disadvantages hospitals in low case mix, low wage areas. For this reason, calculating separate wage indexes for RRCs would be inappropriate. However, if RRCs pay higher wages for each type of labor than their rural neighbors do, some adjustment may be called for.

4.2.1 Six Case Studies of Labor Markets

Every case-study hospital cited examples of workers who were hired from a different State or region. Some searches were even on a national basis. The categories of employees for which these searches were conducted varied greatly, however. For some hospitals, nurses or occupational therapists were hired from a regional or national labor market. Other hospitals hired these workers from in-State urban areas and went out of State for physical therapists and pharmacists. The one category that was consistently hired on an out-of-State basis was that of management.

The simplest explanation for these differences is the presence in the State of a major urban area with many schools for medical personnel. Hospitals in California, Massachusetts, and New York (to pick three States with concentrations of educational institutions), can hire graduates from state schools of nursing, occupational therapy, physical therapy, and technologists. Hospitals in Maine, Delaware, and Nevada, by contrast, do not have many options for hiring in-State.

The question is where do other rural hospitals hire employees in those categories? For rural hospitals near a RRC the answer appears to be: from the RRC down the road! Not all vacancies are filled this way, of course, but the flow of workers seems to be from RRCs to other rural hospitals and not vice-versa. This was confirmed in a number of telephone interviews with the administrators of rural hospitals within the service areas of case study hospitals. Rural hospitals outside the service area of an RRC would appear to hire from urban areas more than those near an RRC do.

In all cases, wage differentials should reflect the employees' tradeoffs between the advantages and disadvantages of working in each type of hospital and in each location. Workers hired from RRCs to other rural hospitals may be moving because the smaller hospitals offer higher, not lower, wages. On the other hand, workers may leave RRCs to gain some other benefit, such as a less demanding caseload, even though the wages are the same or less at the smaller rural hospital.

It is not possible to completely isolate the higher wages versus the more expensive occupational mix arguments using the data collected for the case studies. Three major problems were: different job definitions that would make the data noncomparable, the unavailability of average figures for some categories in some hospitals, and different dates for changing pay scales in different hospitals. The last was the easiest to resolve. Hospitals were asked when the pay scale had last been revised. Virtually all had been reviewed in the previous 3 months and comparisons could be made with the most recent wage figures. The differences in job definitions did not pose as great a problem as the unavailability of average wage rates. Sometimes only ranges of minimum and maximum wages in an occupational category were available for comparisons.

Despite these problems, the case studies provided useful insights. It was often true that RRC wages were higher than those of other rural hospitals although not always for the categories stressed by the administrators of the RRCs. For example, in one area the RRC paid higher average wages for most categories but not for staff Registered Nurses (RNs) as the administrator claimed. This may have been due to a heavier reliance on Licensed Practical Nurses (LPNs) in the non-RRC hospitals and more supervising work for RNs (and higher salaries) even though they were not called head nurses in these other rural hospitals. Varying occupational mixes and the reliance on both lower skilled and part-time workers greatly complicate the analysis of wages, as was clear from the case studies.

4.3 RRC Wage Rates and Occupational Mix: A National Analysis

These case studies suggest that average wages in RRCs might indeed be higher than in other rural hospitals, but that it was not just a matter of higher wage rates. The mix of occupations in RRCs is also expected to play a large role in raising average salaries vis-a-vis other rural hospitals.

Another set of national occupational data was available to address the issues of higher wages and occupational mix. This was the 1983 AHA annual survey, which included questions about the numbers for full-time, part-time and contracted workers plus vacancies for 22 labor categories as well as "all other." (See Data Appendix for more details on definitions and cleaning.)

4.3.1 Occupational Mix

Table 4-1 shows the mean number of full-time and part-time employees for the three groups of hospitals in 1982. RRCs had an average of 660 FTE workers versus 165 for other rural hospitals and 878 for the average urban hospital. These figures are very similar to the means for 1984 presented in Table 2-4. The ratio of part-time FTEs to total FTEs indicates that RRCs are less reliant on part-time employees than other rural hospitals (13 percent vs. 16 percent). This is consistent with the case study reports that many RRCs could not find enough part-time nurses to provide flexibility in the nursing schedules.

Table 4-1 also presents the proportion of FTEs in categories suggested by administrators as potentially more highly paid in RRCs than in other rural hospitals. These were RNs, nurse practitioners, pharmacists, medical technologists, dieticians, all radiologic personnel, and other professional categories not described as assistants (e.g., occupational or physical therapists excluding assistants). The proportions in Table 4-1 confirm the information given in the case studies. RRCs and urban hospitals have higher proportions of the more highly skilled workers than other rural hospitals (30 percent vs. 25 percent).

However, inspection of Table 4-2 suggests that this may be due primarily to the number of nurses employed in RRCs, not the other categories of special workers. Table 4-2 presents the mean number of full-time employees per 100 admissions (to standardize for hospital size) for selected occupational categories. In 1982, the average RRC used 5.75 FTEs for every 100 admissions versus 5.44 in other rural hospitals and 7.12 in urban ones.

The most striking differences across occupational categories are for administrators, RNs, other nursing personnel, and dietetic technicians. RRCs use significantly fewer administrators that do other hospitals. A separate check shows that RRCs do not make up this difference by a heavier reliance on part-time or contracted administrators nor did they have a large number of administrative vacancies in 1982. They simply used 50-100 percent fewer persons for their size.

In nursing, RRCs use far more full-time nurses than do other rural hospitals (1.14 vs. 0.88) but not as many as urban hospitals (1.42). Their use of full-time LPNs, nurse practitioners (too few to appear in the table), and ancillary nursing personnel were not much different from other hospitals, but they do use less "other nursing personnel." Taken as a total, RRCs used 0.20 more full-time nursing personnel per 100 admissions than other rural hospitals and 0.33 fewer than urban hospitals. Other rural hospitals did not make up this difference in their use of part-time or contracted nursing services. Urban hospitals, on the other hand, used more of these categories of labor than rural hospitals; hence, they were even more nursing intensive than Table 4-2 would indicate.

TABLE 4-1

MEAN NUMBERS OF POSITIONS BY EMPLOYMENT STATUS AND TYPE OF HOSPITAL, 1982

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Mean number of:			
Full time equivalents[a]	660	165	878
Total full-time employees	572	138	753
Total part-time employees	177	53	250
Total contracted personnel	10	5	19
Total Vacancies	19	4	30
Reliance on part-time employees[b]	13%	16%	14%
Proportion of FTEs Designated as more highly paid.[c]	30%	25%	31%

[a]FTE = Total full-time employees plus one-half the number of part-time employees.

[b]Proportion of (1/2)*(Part-time Employees) to FTEs.

[c]The full-time and part-time employees in categories identified in the case-studies as potentially more highly paid in RRCs than other rural hospitals were summed for each hospital. The sum for part-time employees in these categories was divided by 2 (to obtain a full-time equivalent). This figure was added to the sum for the full-time categories and the result was divided by total FTEs.

Source: AHA Annual Survey of Hospitals, 1983.

TABLE 4-2

MEANS FOR FULL-TIME EMPLOYEES PER 100 ADMISSIONS BY OCCUPATIONAL CATEGORY AND TYPE OF HOSPITAL, 1982

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Mean number of:			
Total Full-time Employees[a]	5.75	5.44	7.12
Administrators	0.05	0.11	0.08
MDs	0.01	0.01	0.04
RNs	1.14	0.88	1.42
LPNs	0.57	0.57	0.53
Ancillary Nursing Personnel	0.61	0.60	0.63
Other Nursing Personnel	0.24	0.31	0.31
Pharmacists	0.05	0.03	0.06
Pharmacy Technicians	0.05	0.03	0.05
Medical Technologists	0.15	0.15	0.20
Other lab personnel	0.12	0.10	0.15
Dieticians	0.02	0.02	0.03
Dietetic Technicians	0.06	0.15	0.07
Radiographers	0.11	0.10	0.13
Rad. Therapy Technologists	0.01	0.01	0.01
Nuclear Medicine Technologists	0.01	0.04	0.02
Other radiologic personnel	0.06	0.04	0.07
Physical Therapists	0.03	0.02	0.04
Physicial Therapy Assistants	0.03	0.03	0.03
Respiratory Therapists	0.04	0.03	0.06
Respiratory Therapy Technicians	0.06	0.04	0.06
Other Professional and Technical Personnel	0.28	0.16	0.40
All other	1.90	1.89	2.43

[a]Columns do not add to total, due to a few categories omitted because of their extremely small values.

Source: AHA Annual Survey of Hospitals, 1983.

Any differences in the use of full-time radiological personnel (a category stressed in the case studies as very important to costs) were very small with RRCs using marginally 0.01 fewer than other rural hospitals (.18 vs. .19) and 0.05 fewer than urban hospitals (.18 vs. .23). The differences were not made up by the use of part-time employees.

4.3.2 Wage Rates

The difference in the overall proportions of "highly-skilled" to "other" personnel (.30 vs. .25) appears to be due primarily to more intensive use of nursing staff in RRCs compared to other rural hospitals. This in turn may be due entirely to the more complicated cases with longer LOS in RRCs than in other rural hospitals. Indeed, on a per admission basis (see Table 4-3), nursing salaries are indeed higher than in other rural hospitals, but not disproportionately compared to other hospital salaries.

Table 4-3 presents a variety of salary and benefit figures for 1982. Average salary per employee is clearly higher (by $1,660) in RRCs than in other rural hospitals and lower (by $1,708) than in urban areas. Benefits (as measured by the AHA survey) are somewhat lower in RRCs than in other hospitals, but not enough to offset the higher salaries. The total wage package is 11.5 percent higher in RRCs than in other rural hospitals and 11.8 percent lower than in urban areas.

When calculated per admission, RRCs pay salaries and benefits that are 14.7 percent higher than other rural hospitals ($969 vs. $846) and 30.8 percent lower than in urban hospitals ($969 vs. $1,387). This may reflect the more intensive use of labor in urban hospitals. However, nonlabor costs were also higher in urban hospitals so that the higher labor intensity per admission in urban hospitals does not translate into a large increase in labor's share of the total cost per admission (56 percent in all rural hospitals versus only 57 percent in urban areas).

Although these figures suggest that the line of reasoning advanced by RRCs is correct, we know from Chapter 3 that much of the differences in wages are likely to be explained by the relative wages of the area where a hospital is located. This probably explains much of the difference between the urban and rural salaries, for example. To control for this, we need to use regression analysis.

TABLE 4-3

SALARIES AND EMPLOYEE BENEFITS BY TYPE OF HOSPITAL, 1982

	Rural Referral Centers	Other Rural Hospitals	Urban Hospitals
Mean:			
Salary per Employee	$14,503	$12,843	$16,211
Benefits per Employee	2,743	2,627	3,347
Benefits as % of Salaries	19%	20%	21%
Total Cost per Admission	$ 2,003	$ 1,747	$ 2,868
Total Salaries per Admission	969	846	1,387
Salaries as % of Total Costs	48%	48%	48%
MD Salaries per Admission	$ 11	$ 8	$ 32
Nursing Salaries per Admission	357	312	473
Other Salaries per Admission	599	551	865
Benefits per Admission	155	134	238
Salaries plus benefits % of Total costs	56%	56%	57%
Professional fees per Admission	112	126	161
Contract fees per Admission	2	4	20

Source: AHA Annual Survey of Hospitals

4.3.3 Regression Analysis to Explain Wage Differences

Five regressions explaining wage differentials within HCFA's currently defined labor markets are presented in Table 4-4. The first uses only the hospital's designation as an RRC, other rural or urban hospital to explain wage variation within each labor area. The constant term is 1.06, indicating that, on average, RRCs wages that are 106 percent of the State-wide rural average. The coefficient for other rural hospitals is -0.11, indicating an average wage that is 95 percent (1.06-.11) of the State-wide rural average. The average urban hospital has wages that are 9 percent lower than the MSA average.*

The second column controls for the hospital's occupation mix, the proportion of part-time employees, and the proportion of MDs on the payroll. A hospital's location may proxy for these worker characteristics: being an RRC is associated with a lower proportion of part-time employees and with the mix of occupations. When these staff characteristics are held constant, the RRC versus other hospital wage differential is reduced, but all four are statistically highly significant. All of the staff characteristics are significant at the 1 percent level.

Column 3 reports the effects of further controlling for the relative case mix index of each hospital. This model was estimated to see if the mix of cases had an effect on wages separate from that of the employee occupational mix. While a hospital treating more complex cases may require a higher proportion of highly skilled labor, it may also use workers at every level who are more experienced or have more education. This would contribute to higher relative wages within occupation. Indeed, the measure of relative case mix had a large (0.28) and highly significant effect on hospitals' relative wages, even holding occupational mix constant. It was correlated with the employee occupational mix and the hospital's case mix but reduced the effect of RRC designation on wages by about one-third.

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*It may seem paradoxical that the constant term plus the other rural dummy coefficient do not exceed 1.0, implying that all rural wage rates are below the State-wide average. The seeming discrepancy arises because the PPS wage index is weighted by hours worked in each hospital while the mean values represented by the constant and coefficient weight each hospital equally regardless of the number of FTEs or hours worked. Low wage hospitals tend to have fewer FTEs. Therefore, a hospital weighted average is lower than an hour weighted one.

TABLE 4-4

EXPLAINING INTRA-LABOR-MARKET HOSPITAL WAGES, 1982

	Dependent Variable: Ratio of Each Hospital's Gross Average Wage to Labor-Market-Wide Average				
	(1)	(2)	(3)	(4)	(5)
Constant[a]	1.06***	0.89***	0.61***	0.54***	0.60***
Other Rural Hospitals	-0.11***	-0.08***	-0.05***	-0.04***	-0.03***
Urban Hospitals	-0.09***	-0.06***	-0.04***	-0.05***	-0.05***
Ratios:					
Proportion of high pay FTEs to average proportion		0.18***	0.16***	0.14***	0.14***
Proportion of FTEs that are part-time to average proportion		-0.04***	-0.04***	-0.04***	-0.03***
Proportion of FTEs that are MDs to average proportion		b***	b***	b	b
Hospital casemix index to average casemix			0.28***	0.19***	0.12***
Median Gross Rent of County to Average Median Gross Rent				0.16***	0.16***
Teaching Hospital				0.04***	0.02***
Part of a multi-hospital system				0.03***	0.03***
Hospital bedsize					b***
R^2	.02	.11	.13	.17	.17

N = 4410

***Significant at 1 percent level.
[a]RRCs are in the constant.
[b]Less than 0.005.

Adding the relative median gross rent for the county as an explanatory variable along with the hospital's teaching status and membership in a multihospital system, however, reduced the size (by about a third) and statistical significance of the case mix ratio's coefficient.

What do these results indicate about the wages of rural referral hospitals? Within the current HCFA rural labor markets, hospitals designated as RRCs pay wages that are roughly 10 percent higher than other rural hospitals. This difference is statistically highly significant . It is reduced by about one-half when a number of hospital-specific characteristics including case mix are controlled for. When the relative median gross rent for the county is included along with additional hospitals characteristics, no more of the wage differential is explained although the factors explain much more of the variance. The median gross rent may be a proxy for intra-area differences in the cost of living since it includes utility costs, or it may reflect population density and differences in the demand for hospital services that require hospitals to require a more skilled labor mix; that is, in busier areas, patients and doctors may demand more highly qualified staff at every skill level.

4.3.4 The Effect of Location Near an SMSA Boundary

Our search for a subset of the RRCs with higher average costs per case led us to examine the location of selected RRCs to see if those with high, unexplained costs were located near the border of an urban area. Such a location might cause these hospitals to compete for all workers with their urban neighbors in a way that is not the case elsewhere. This competition would lead to higher than average wages (unexplained by the rural wage index) and therefore higher costs per admission.

To study this possibility, we selected the RRCs with the 20 highest and 16 lowest cost residuals in eq. (4), Table 3-1 (unexplained total costs per admission) and estimated, from a map, the number of road miles to the boundary of the nearest SMSA. The high cost RRCs averaged 87 miles from the nearest SMSA while the low cost RRCs were only 38 miles. This suggests that being farther from an SMSA leads to higher costs, but the range was so great that a

strong conclusion cannot be drawn. The distances for the high cost RRCs ranged from 5 to 384 miles. One hospital that was only 7 miles from the nearest SMSA had a high unexplained wage, suggesting that it may be competing with an urban labor market. However, an RRC in Alaska is both very far away from the nearest SMSA and has a very high unexplained wage index.

The distances for the low cost RRCs range from 8 to 95 miles. One hospital with a low unexplained total cost was a distance of 95 miles from an SMSA. It had a very low unexplained wage index which may be explained by the lack of competition with the urban market. However another hospital, only 13 miles away from the nearest SMAA, has an even lower unexplained wage index.

As a general rule, it cannot be concluded that the RRC's with high unexplained total costs are competing with nearby urban labor markets. However, it may be true for certain individual hospitals.

To further examine the effect of location on RRC wages we asked: what would happen to RRC PPS payments if wage indexes were calculated separately for adjacent and nonadjacent counties within each State? In general, for RRCs very little would change. RRCs are not consistently in the high wage area whether it is the adjacent or nonadjacent counties.* Dummy variables for rural location were not significant explanatory factors. Nor were the regression coefficients different when models explaining wage differentials within adjacent rural and nonadjacent rural labor markets were explored. RRCs were stil found to pay consistently higher wages, given their labor market areas, than either other rural or urban hospitals.

Further, high wage hospitals are usually big hospitals. Therefore, the current PPS rural wage indexes, which are weighted by total salaried hours, are already generally close to the separate wage index (either adjacent or nonadjacent) that includes these high wage hospitals. For example, in Alabama, Florida or Virginia, where adjacent wages are higher than nonadjacent wages, a separate wage index for adjacent-only hospitals would raise their per case payments by $14.21-$18.63 (for a case with DRG weight of

*See Cromwell, Hendricks and Pope, report on Geographic Refinements to PPS Payment Adjustments, HCFA Contract No. 500-85-0015, Chapter 4 for further discussion of adjacent/nonadjacent wages.

1.0) or only 0.7-0.9 percent of the total payment. In Massachusetts, adjacent hospitals would gain 3.9 percent. In Colorado, where nonadjacent wages are higher, a separate wage index would raise payments by 3.8 percent ($84 for a case weighted 1.0).

For the rural group with the lower wage index, generally made up of smaller hospitals, the change would be more marked. In Alabama and Virginia, for instance, the nonadjacent hosptials would lose 2.1-2.4 percent per payment. However, a nonadjacent wage index in Florida would reduce those hospitals' payments by 14.6 percent, in Colorado there would be a 10.9 percent drop, and in Massachusetts, 25.4 percent reduction per case.

Any change in the index will cause some hospitals to gain and others to lose. These percentages illustrate the size of the effect of a wage index change on groups of hospitals. The gains or losses for individual hospitals will vary more. Because RRCs are among the high wage rural hospitals, a wage index calculated separately for rural counties adjacent to urban areas versus nonadjacent rural counties will not in itself make a marked difference for RRC payments.

This stage of the analysis confirms that there is a significant difference in wages within the rural hospital market according to a hospital's designation as an RRC. However, it is explained, in part, by hospital staffing practices and by the relative costs of living faced by its workers within the market. Perhaps a labor market definition that captures differences in living costs or other economic activity may correct this possible cause of wage variations. This will require additional research.

5.0 POLICY IMPLICATIONS OF FINDINGS

Research focused on the Medicare costs and revenues of RRCs has clearly shown that these hospitals, while having higher costs than other rural hospitals, do not have costs that equal those of urban hospitals. The initial method of payment for RRCs--the urban rate applicable in the closest MSA--has been overly generous. Therefore, RRCs have obtained the highest positive Medicare operating margin under PPS of any major type of hospital. Paying RRCs only the rural rate would have a large negative impact on all RRCs. However, continuing to pay the full urban rate would inappropriately result in windfall profits, especially relative to other rural hospitals. Accordingly, HCFA is considering alternatives for paying RRCs less than the full urban rate. This would bring RRCs' operating margins more into line with other hospitals' operating margins.

REFERENCES

Baron, D.P., "The Economics of Hospital Obstetrics Care", Journal of Economics and Business, 30(Winter 1978):98-107.

Chassin, Mark R., "Health Technology Case Study 24: Variations in Hospital Length of Stay: Their Relationship to Health OUtcomes. Washington, D.C.: U.S. Congress, Office of Technology Assessment, OTA-HCS-23, August 1983. This case study was performed as a part of OTA's assessment of Medical Technology and Costs of the Medicare Program.

Cowing, T.G., and A.G. Holtman, "The Multiproduct Short-run Hospital Cost Function: Empirical Evidence and Policy Implications from Crossection Data", Southern Economic Journal, 49, January 1983:637-653.

Cromwell, J., A. Hendricks, and G. Pope, Report on Geographic (Urban-Rural) Refinements to PPS Payment Adjustment, Report to HCFA under Contract No. 500-85-0015, September 30, 1986.

Eastaugh, Steven R., "Hospital Diversification and Financial Management," Medical Care 22(8):704-723, August 1984.

Griffith, John R., Measuring Hospital Performance, Chicago: Blue Cross Association, 1978.

Hendricks, A., G. Pope, and J. Cromwell, An Evaluation of Limitations in the Current PPS Adjustment for Area Wage Rates, Report to Prospective Payment Assessment Commission, Contract No. T-31416922, May 2, 1986.

Judge, George G., William E. Griffiths, A. Carter Hill, and Tsoung-Chao Lee, The Theory and Practice of Econometrics, New York: John Wiley and Sons, 1980.

Lave, Judith R., "The Medicare Adjustment for the Indirect Cost of Medical Education: Historical Development and Current Status," January, 1981.

Pauly, M.V. "Medical Staff Characteristics and Hospital Costs," Journal of Human Resources 13(supplement)1978:77-111.

Pettengill, Julian, and James Vertress, "Reliability and Validity in Hospital Case-Mix Measurement," Health Care Financing Review, (4)2:101-128, December 1982.

Pindyc, Robert S. and Daniel L. Rubinfeld, Econometric Models and Economic Forecasts, 2nd ed., New York: (Report prepared for the Association of American Medical Colleges), McGraw Hill Book Company, 1981.

Watts, Carolyn A., and T.P. Klastorin, "The Impact of Casemix on Hospital Cost: A Comparative Analysis," Inquiry (17)4:357-367, Winter 1980.

Weinschrott, David J., "Multiproduct Cost Relationships in Local Hospital Markets: Evidence from Cross-Section Time Series Data", Paper presented to the American Economic Association, December 29, 1982.

APPENDIX A

DATA SOURCES AND METHODS

A.1 Introduction

This appendix contains a description of the sources, construction and contents of the data base that was used in this report. The mandate for this report required that a wide range of issues be covered, necessitating the compilation of data for hospitals, not just on Medicare beneficiaries, costs, and payments, but also on local area characteristics, scope of services, and non-Medicare financial and utilization variables. With the exception of some financial variables, the data presented in this report were not derived from a sample of hospitals, but rather from an actual census of hospitals that are covered by the Prospective Payment System (PPS). Most of the analysis and data are for the year 1984, although for certain sections data for the earlier years 1981-82 are used.

A.2 File Construction

Four primary sources were merged to construct the analytical file: Medicare Cost Reports for 1981, the Medicare Impact FY87 file, the Area Resource File, and the American Hospital Association Annual Survey of Hospitals. For the hospital sources, data were available for the years 1981 and 1984. The Medicare Cost Reports (MCR) and Impact File contain the hospital characteristics and financial and utilization data that are provided by hospitals in order to obtain payment for treating Medicare patients. The Area Resource File (ARF) provides data on a variety of local area characteristics at the county level. The American Hospital Association (AHA) Annual Survey of Hospitals provides detailed information on admissions, costs, ownership, types of service, and personnel for responding hospitals.

Hospitals that are excluded from the coverage of PPS were also excluded from the analytical file. The primary excluded hospital types are: psychiatric, rehabilitation, alchol/drug treatment, children's, and long term care. A few other hospitals amounting to less than a half of one percent of the original number on the file, were eliminated because they had missing or incorrect data for several important variables, such as case mix index, total or Medicare expenses, or total or Medicare admissions. (See section A.4.1)

A.3 Variable Definitions and Cleaning

This section describes the variables used for the empirical work in this study, their sources, any limitations, replacement of values and cleaning. For exposition purposes, the variables are grouped into broad categories: utilization vs. costs, etc.

A.3.1 Hospital Location, Ownership, Teaching Status

A hospital's location was determined in two ways. First, it was designated an "urban" hospital if there was an SMSA number in the AHA data. Otherwise, the hospital was "rural". The AHA variable designating the SMSA had far less missing data than did the Medicare SMSA variable. Even so, additional checks uncovered approximately 100 hospitals that were miscoded and these were corrected. A hospital was also located in a state and census region using its provider identification number from the MCR data. There were no missing data on this six-digit variable, whose first two numbers give the state.

A hospital's ownership and one measure of teaching status were obtained from the Medicare Cost Report. The designations of "church" and "other voluntary non-profit" were combined as "Private Non-profit" for use in descriptive tables. To determine a hospital's teaching status, the number of interns and residents was obtained from the MCR and divided by the number of beds available at the end of the reporting period (also reported on the Medicare form).

Other measures of teaching involvement and a hospital's JCAH accreditation were taken from AHA data.

A.3.2 Market Characteristics

Most of the characteristics of the county in which a hospital was located (presented in Table 2-2) were obtained from the Area Resource File, a data set compiled and maintained by the Bureau of Health Professions of the Department of Health and Human Services. The exceptions were the number of acute care

hospitals in the county and the number of hospital beds. Both of these were constructed from the MCR data by summing the number of acute care hospitals and beds in these hospitals within each county. The area wage index is from the Impact FY87 file.

A.3.3 Size and Utilization Statistics

The three measures of a hospital's bedsize in 1981 were obtained from the Medicare Cost Report. They represent the number of inpatient beds available at the end of the reporting period. The number of inpatient days for all patients and for Medicare patients were also taken from the MCR.

The number of admissions were used instead of the number of discharges in 1981. This was due to errors in the available discharge data that apparently overstate both total discharges and Medicare discharges by 50 percent on average. This is a very large discrepancy so the choice of admissions could make a difference in the empirical work. admissions were preferred over discharges for several reasons. First, MCR discharges produced average costs per discharge that seemed unreasonably low, while Medicare admissions produced much more reasonable average costs. Second, the time trend of admissions for a given hospital appeared more consistent than for discharges. Of the two choices in measuring total admissions, the AHA number (excluding newborns) was preferred because of less missing data, expecially for earlier years. Medicare admissions were taken from the MCR. The reporting period for the AHA survey differs slightly from that for Medicare. Therefore, the number of admissions is not measured over the same period as are inpatient days. This leads to a possible underestimate of average length of stay of about 2 percent. This was judged to be a smaller error than the possible overall error that would result from a smaller sample of hospitals due to missing values. For 1984, these were not considerations.

The number of full-time equivalent employees (FTEs) was obtained from the AHA survey data which again had more complete values. In addition, the survey provided additional measures of utilization, including the number of surgical operations, visits to the emergency room, and to outpatient departments.

A.3.4 Cost Statistics

The total cost for all inpatients was also obtained from the AHA annual survey, where it is called total expenses. This meant that it measures costs for the same reporting period as total admissions and avoids bias in the cost per admission. The AHA expense figure is for the total facility and includes the costs of emergency rooms, OPDs, and nursing home units from some 670 institutions. Because these long term costs are not paid for under Medicare but cannot be subtracted from the 1981 cost figures, the hospitals with nursing homes were flagged so that this source of additional cost could be controlled for in regressions. These hospitals were excluded from the descriptive means.

The Medicare cost figures were from the MCR. The figure used was called "Total Inpatient Cost Applicable to Title XVIII" and was reported on worksheet E, Part 1, Column 1, page 33, line 12 of the MCR. It includes depreciation and interest costs allocated to the various cost centers of the hospital, but the excludes all uncovered Medicare services, e.g., maternity. It differs from the AHA figure in two major ways. First, Medicare costs are only the fraction of total expenses corresponding to costs incurred by Medicare patients only. Second, all outpatient costs are excluded.

The figure for 1981 salaries was calculated from the AHA total expenses and total nonpayroll costs. Total nonpayroll costs includes employee benefits, professional fees and payments for contracted services in additionto depreciation, interest and medical supplies. Total expenses included salaries for medical doctors and residents. Residents salaries are reimbursed separately under PPS and should therefore be subtracted from total expenses. No correction for residents' salaries was possible, due to missing data. No cleaning or trimming of the values for salaries was done.

A.3.5 Scope of Services

The AHA in its annual survey asks hospitals to report whether they offer one or more of nearly 50 specialized services. We selected about 20 of the more complex or access-oriented services for analysis.

The major drawback of these 0, 1 codes is that they give no indication of how large a service it is or how underutilized it might be. To provide a more continuous measure of size, we used some MCR cost statistics on 5 special services: operating rooms (including operating room, recovery room, and anesthesia delivery rooms), all radiology (including diagnostic, therapeutic, and radiostope), all laboratory, and physicial therapy. Costs are defined as post-stepdown expenses to a particular department. We also took a total ancillary cost figure from the MCR report to measure the ancillary orientation of the institution.

A.3.6 Occupational Mix

Information on the number of workers in 22 occupational categories comes from the 1982 AHA survey of hospitals. The special survey also included numbers of contracted workers and vacancies for the same categories. There were complete data for 5,134 hospitals including 113 RRCs, 1,858 other rural hospitals and 2,108 urban hospitals. Approximately 40 hospitals were excluded because their reports were for less than a full year.

In calculating salaries, costs, and admissions, the values for 1982 were used. The designation as an RRC or other type of hospital and the wage index were merged from the 1981 described above.

A.3.7 Data Cleaning

The files for the years 1981 were extensively examined in order to insure that the data contained reasonable information. Data that were determined to be unusable were either eliminated or, in a few cases, corrected. In this section we describe this process.

The data were examined by constructing a number of ratios for each hospital, such as:

Cost per admission
Cost per Medicare admission
Cost per day
Cost per Medicare day

Average length of stay
Occupancy rate
Surgical operations per admission
Ratio of Medicare admissions to total admissions
Personnel per bed
Percent of ancillary costs spent on a specific ancillary service
Ratio of ancillary costs to total costs.

For each of these ratios, approximately the top and bottom one percent of the distribution of values were examined. By examing a number of these ratios at the same time, it was possible to determine whether extreme values were valid, and therefore should be left in the file, or were invalid data that should be changed to missing. In some cases, the value of the ratio was so extreme that it clearly indicated bad data. For example, for one hospital the average length of stay per Medicare admission was found to be 135 days, an unrealistically high figure. In this instance, the percentage of admissions due to Medicare patients was calculated to be 2 percent, an extremely low percentage. As a result, it was concluded that the Medicare admissions figure was incorrect, and we set it to missing.

However, some extreme values did not obviously represent bad data. In these cases the values of other ratios were also examined to determine whether the flagged variable indicated the need to change a data value. For example, if for a given hospital the average cost of a Medicare admission was flagged because it was extremely high, but not unbelievable, and the average cost of all admissions was also high, then the flagged value was allowed to remain. Suspicious values were also checked when possible with data presented in issues of the American Hospital Association Guide to the Health Care Field. In a few cases this allowed for the replacement of incorrect data with valid values.

In summary, data values were not eliminated simply because they were at the end of the distribution. For 1981, a total of 23 hospitals were eliminated from the sample because they had invalid values for a number of variables important to this analysis (and in many cases did not even have a hospital name or address). For all variables, a total of 20 values were changed to missing for hospitals that were retained in the sample.

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